Carrier
TRANSICOLD

Bus Air Conditioning Equipment

Models
GR-45
GR-60
(N. A. O.)

OPERATION AND SERVICE

T-295

Carrier
TRANSICOLD

OPERATION AND SERVICE MANUAL

BUS AIR CONDITIONING UNIT

Models

GR-45

GR-60

(N. A. O.)

Carrier Refrigeration Operations
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Carrier
A United Technologies Company

SAFETY SUMMARY

GENERAL SAFETY NOTICES

The following general safety notices supplement the specific warnings and cautions appearing elsewhere in this manual. They are recommended precautions that must be understood and applied during operation and maintenance of the equipment covered herein. A listing of the specific warnings and cautions appearing elsewhere in the manual follows the general safety notices.

FIRST AID

An injury, no matter how slight, should never go unattended. Always obtain first aid or medical attention immediately.

OPERATING PRECAUTIONS

Always wear safety glasses.

Keep hands, clothing and tools clear of the evaporator and condenser fans.

No work should be performed on the unit until all circuit breakers and start-stop switches are placed in the OFF position, and power supply is disconnected.

Always work in pairs. Never work on the equipment alone.

In case of severe vibration or unusual noise, stop the unit and investigate.

MAINTENANCE PRECAUTIONS

Beware of unannounced starting of the evaporator and condenser fans. Do not open the unit cover before turning power off.

Be sure power is turned off before working on motors, controllers, solenoid valves and electrical controls. Tag circuit breaker and power supply to prevent accidental energizing of circuit.

Do not bypass any electrical safety devices, e.g. bridging an overload, or using any sort of jumper wires. Problems with the system should be diagnosed, and any necessary repairs performed, by qualified service personnel.

When performing any arc welding on the unit, disconnect all wire harness connectors from the modules in the control box. Do not remove wire harness from the modules unless you are grounded to the unit frame with a static-safe wrist strap.

In case of electrical fire, open circuit switch and extinguish with CO_2 (never use water).

SPECIFIC WARNINGS AND CAUTIONS

WARNING

DO NOT USE A NITROGEN CYLINDER WITHOUT A PRESSURE REGULATOR

WARNING

DO NOT USE OXYGEN IN OR NEAR A REFRIGERATION SYSTEM AS AN EXPLOSION MAY OCCUR.

WARNING

THE FILTER-DRIER MAY CONTAIN LIQUID REFRIGERANT. SLOWLY LOOSEN THE FLARE NUTS AND AVOID CONTACT WITH EXPOSED SKIN OR EYES.

CAUTION

Do not under any circumstances attempt to service the microprocessor. should a problem develop with the microprocessor, replace it.

CAUTION

If unit was recently operated, be careful of remaining hot coolant in the hoses when disassembling.

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SECTION 1

DESCRIPTION

1.1 INTRODUCTION

This manual contains Operating Instructions, Service Instructions and Electrical Data for the Model GR Air Conditioning and Heating equipment furnished by Carrier Transicold Division as shown in Table 1-1.

Model GR systems consists of an Apex Unit, containing the condenser and evaporator and an engine compartment mounted compressor. To complete the system, the air conditioning and heating equipment interfaces with electrical cabling, refrigerant piping, engine coolant piping (for heating), duct work and other components furnished by the bus manufacturer.

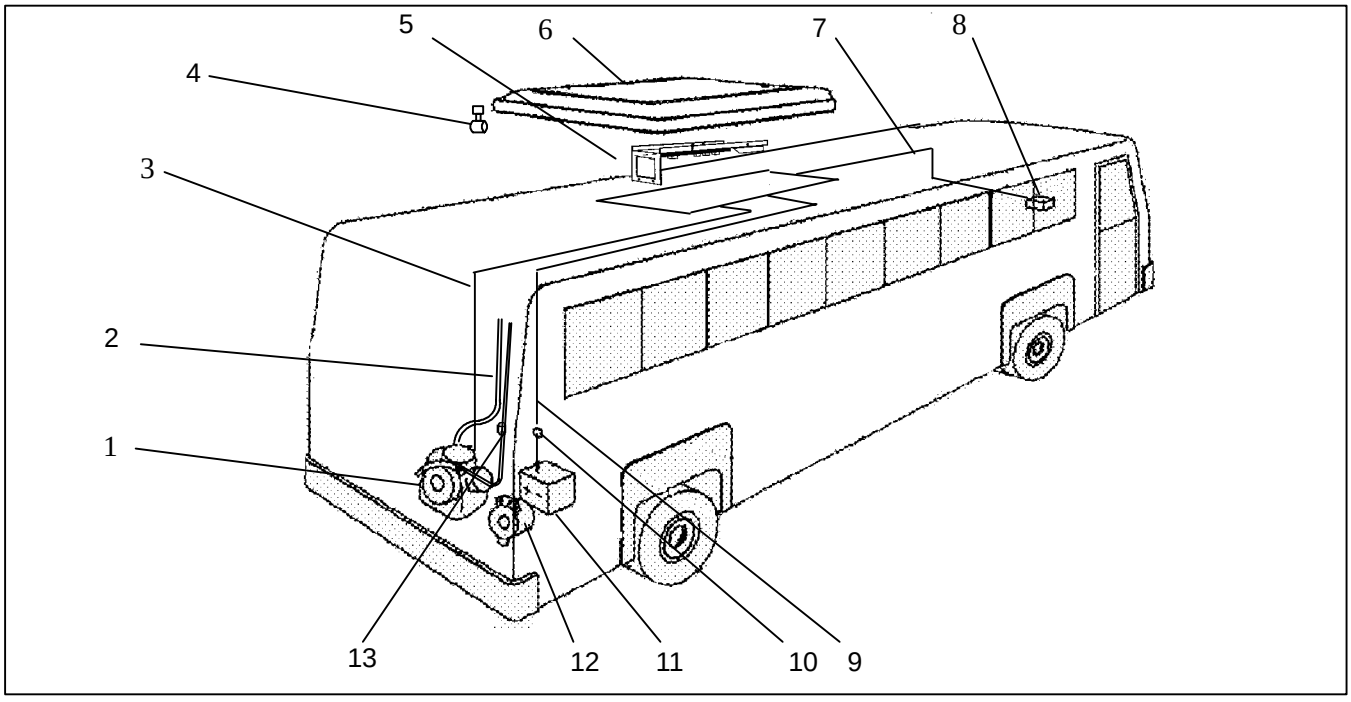
Operation of the units is controlled automatically by a microprocessor based Micromax Controller which maintains the vehicle's interior temperature at the desired set point.

Table 1-1. Model

MODEL	SERIES	COMPRESSOR	CONDENSER FANS	EVAPORATOR FANS
GR45	ROOF MOUNTED	05K	4	4
GR60	ROOF MOUNTED	05G	6	6

Table 1-2. Additional Support Manuals

MANUAL/FORM NUMBER	EQUIPMENT COVERED	TYPE OF MANUAL
62-02491	O5K Compressor	Operation and Service
62-02460	O5K Compressor	Parts List
62-02756	O5G Compressor	Operation and Service
T-200	O5G Compressor	Parts List



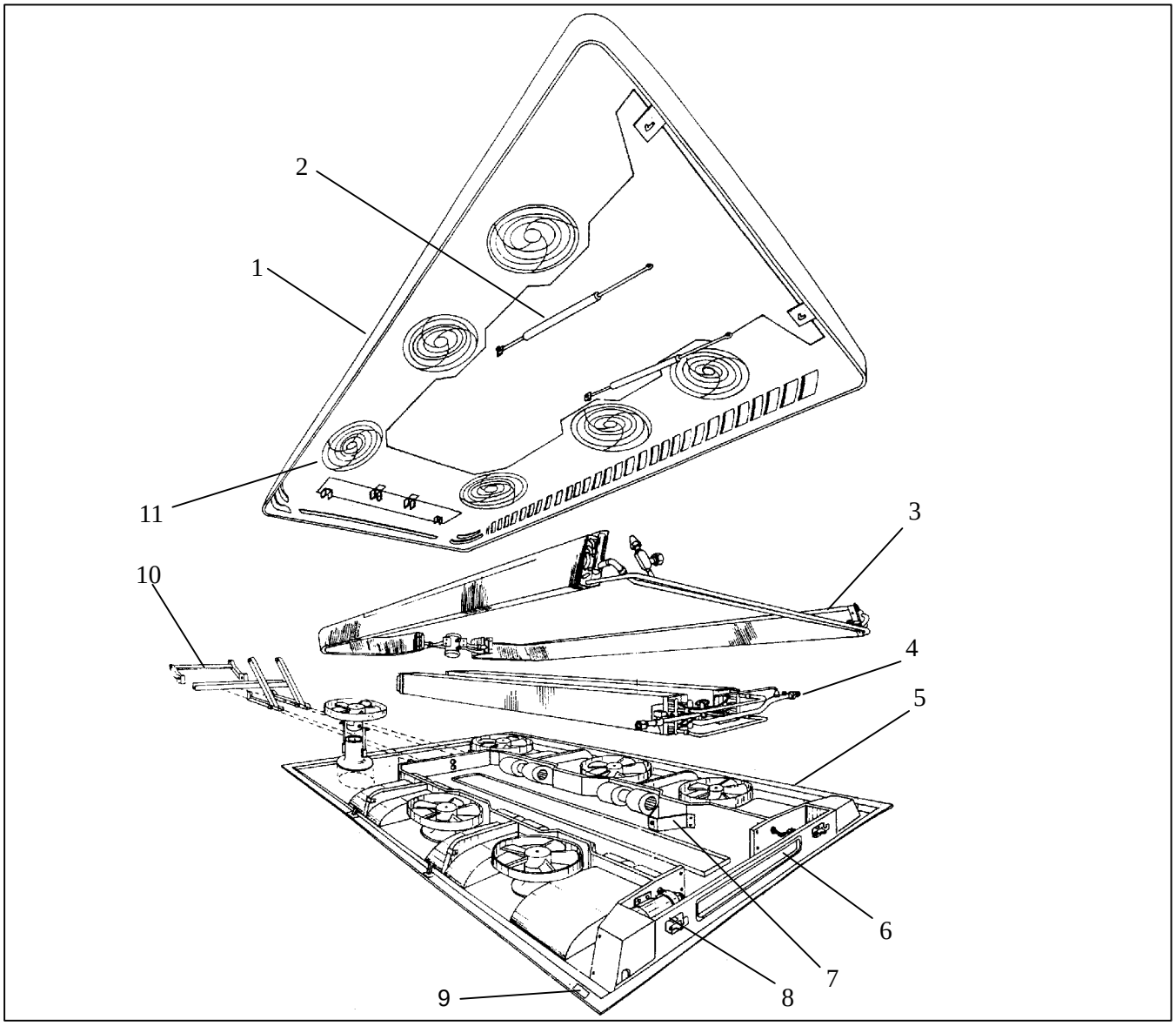
1. Compressor
2. Refrigerant Lines
3. Compressor Harness
4. Heat Valve
5. Electronics Boards
6. Apex Unit
7. Main Harness
8. Driver Control
9. Power Harness
10. Power Relay
11. Battery
12. Alternator
13. Discharge Check Valve

Figure 1-1. A/C Component Identification

1.2 GENERAL DESCRIPTION

1.2.1 Apex Unit

The apex unit (see Figure 1-2) includes the condensing section, evaporator section, Micromax electronics, and the Fresh Air System. All components are accessible by lifting the top cover. Descriptions of the systems are provided in the following sub paragraphs.



1. Top Cover
2. Gas Spring (2)
3. Condenser Section (See Figure 1-3)
4. Evaporator Section (See Figure 1-4)
5. Base
6. Fresh Air System
7. Gas Spring Support (2)
8. Lock (2)
9. Serial Plate
10. Hinge
11. Condenser Fan Grille (4-GR45, 6-GR60)
12. Front Drain (2)*
13. Intermediate Drain (2)*
14. Evaporator Rear Drain (2)*
15. Condenser Rear Drain (2)*

* Not Shown

Figure 1-2. Apex Unit Components
(GR-60 Shown)

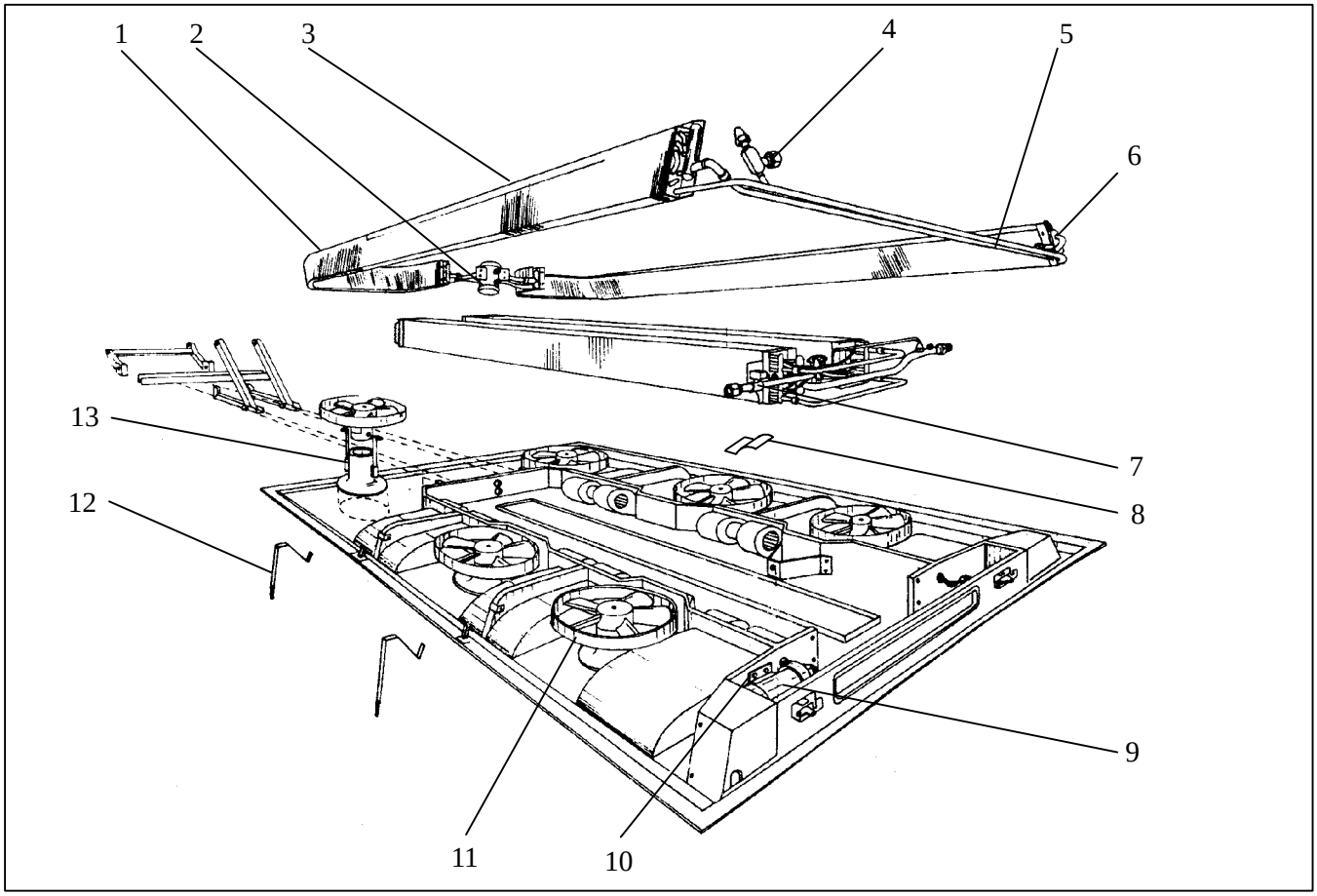
1.2.2 Condensing Section

The condensing section (Figure 1-3) includes the condenser coils, fan and motor assemblies, filter-drier, receiver, liquid line solenoid valve, service valves, and an ambient temperature sensor.

The condenser coils provide heat transfer surface for condensing refrigerant gas at a high temperature and pressure into a liquid at high temperature and pressure. The condenser fans circulate ambient air across the outside of the condenser tubes at a temperature lower than refrigerant circulating inside the tubes; this results in condensation of the refrigerant into a liquid. The filter-drier removes moisture and debris from the liquid refrigerant before it enters the thermostatic expansion valve in the evaporator assembly.

The receiver collects and stores liquid refrigerant. The receiver is fitted with upper and lower liquid level sight glasses to enable determining refrigerant liquid level. The receiver is also fitted with a fusible plug which protects the system from unsafe high pressure conditions. The liquid line solenoid valve closes when system is shut down to prevent flooding of coils with liquid refrigerant. The service valves enable isolation of the filter-drier for service. The ambient temperature sensor measures ambient temperature and sends an electrical signal to the controller.

The discharge check valve is a spring loaded, normally closed valve that opens with the flow of refrigerant from the compressor. When the compressor clutch is disengaged, the discharge check valve will close, preventing the flow of high pressure liquid from the condenser back into the compressor.



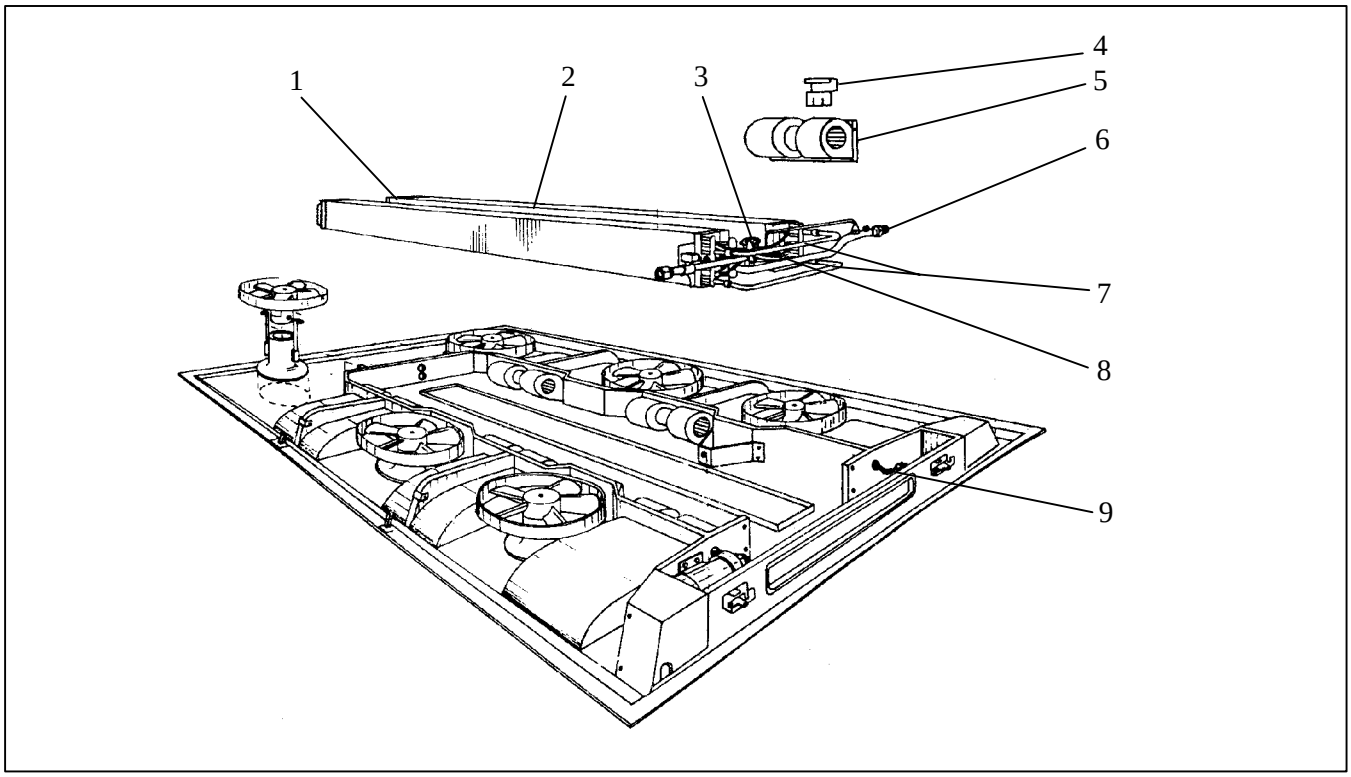
1. Condenser Coil (2)
2. Receiver
3. Protection Plate
4. Service Valve
5. Discharge Line
6. Precharge Valve
7. Liquid Line Solenoid Valve
8. Filter Drier Upper Support
9. Filter Drier
10. Filter Drier Lower Support
11 Condenser Fan and Motor Assembly (4-GR45, 6-GR60)
12. Condenser Coil Fastener (4)
13. Condenser Motor Support (4-GR45, 6-GR60)

Figure 1-3. Condensing Section Components
(GR-60 Shown)

1.2.3 Evaporator Section

The evaporator section (Figure 1-4) includes the evaporator coils, six fan and motor assemblies, evaporator/heater coil assemblies, a thermostatic expansion valve and condensate drain connections.

The evaporator coils provide heat transfer surface for transferring heat from air circulating over the outside the coil to refrigerant circulating inside the tubes; thus providing cooling. The heating coils provide heat transfer surface for transferring heat from engine coolant water circulating inside the tubes to air circulating over the outside surface of the tubes, thus providing heating. The fans circulate the air over the coils. The air filters remove dirt particles from the air before it passes over the coils. The thermostatic expansion valve meters flow of refrigerant entering the evaporator coils. The heat valve controls the flow of engine coolant water to the heating coils upon receipt of a signal from the controller. The condensate drain connections provide a means for connecting tubing for disposing of condensate collected on the evaporator coils during cooling operation.



1. Evaporator Coil With Integrated Heating Coil (2)
2. Protection Plate
3. Expansion Valve
4. Evaporator Motor Fastening Clamps (4-GR45, 6-GR60)
5. Evaporator Motor (4-GR45, 6-GR60)
6. Suction Line
7. Heating Lines
8. Service Valve
9. Evaporator Harness

Figure 1-4. Evaporator Section Components
(GR-60 Shown)

1.2.4 Compressor Assembly

The compressor assembly includes the refrigerant compressor, clutch assembly, suction and discharge service valves, high pressure switch, low pressure switch, suction and discharge servicing (charging) ports and electric solenoid unloaders.

The compressor raises the pressure and temperature of the refrigerant and forces it into the condenser tubes. The clutch assembly provides a means of belt driving the compressor by the bus engine. The suction and discharge service valves enable servicing of the compressor. Suction and discharge servicing (charging) ports mounted on the service valves enable connection of charging hoses for servicing of the compressor, as well as other parts of the refrigerant circuit. The high pressure switch contacts open on a pressure rise to shut down the system when abnormally high refrigerant pressures occur. The electric unloaders provide a means of controlling compressor capacity, which enables control of temperature inside the bus. For more detailed information on the compressor, refer to manual number 62-02756.

1.2.5 Fresh Air System

The Fresh Air System (6, Figure 1-2) consists of a damper and damper operator. The damper operator may be controlled by the driver, if a switch is provided. In the automatic mode, it is controlled by the Micromax to open and close the damper to allow addition of fresh air into the air entering the evaporator coil. For additional information on air flow, refer to paragraph 1.7.

1.2.6 System Operating Controls And Components

The system is operated by a Carrier Transicold Micromax microprocessor controller which consist of a logic board (Figure 1-10), relay board (Figure 1-8 or Figure 1-9), and manual operator switches. The manual operating switches are located on the drivers control and may consist of a single OEM supplied ON/OFF switch, additional OEM supplied switches or a Carrier Transicold supplied Micromate control panel (Figure 1-11). The logic board regulates the operational cycles of the system by energizing or de–energizing relays on the relay board in response to deviations in interior temperature. Modes of operation include Cooling, Heat and Vent. On systems fitted with only an ON/OFF switch and on systems with the Micromate set in the AUTO mode, the logic board will cycle the system between the operating modes as required to maintain desired set point temperature.

In the vent mode the evaporator fans are operated to circulate air in the bus interior.

In the heat mode the heat valve is opened to allow a flow of engine coolant through the heat section of the evaporator coil. The evaporator fans operate to circulate air over the evaporator coil in the same manner as the vent mode.

In the cooling mode the compressor is energized while the evaporator and condenser fans are operated to provide refrigeration as required. The compressor is fitted with cylinder unloaders to match compressor capacity to the bus requirements. Once interior temperature reaches the desired set point, the system may operate in the clutch cycle or reheat mode. A controller programmed for clutch cycle will de-energize the compressor clutch and allow the system to operate in the vent mode until further cooling is required. A controller programmed for reheat will maintain compressor operation and open the heat valve to allow reheating of the return air. In the reheat mode interior temperature is maintained at the desired set point while additional dehumidification takes place.

Controls may also be provided to allow manual operation of the evaporator fans in low or high speed and manual control of the fresh air damper in the open or closed position.

1.3 REFRIGERATION SYSTEM COMPONENT SPECIFICATIONS

a. Refrigerant Charge

R-134a 14.3 lb (6.5 kg)

b. Compressor

UNIT MODEL	GR45	GR60
Compressor	05K	05G
No of Cylinders	4	6
Weight - Dry	108 lbs (49 kg)	137 lbs (62 kg)
Oil Charge	5.5 pints (2.6 liters)	6.75 pints (3.2 liters)

Oil Level:
Level in sight glass between Min.-Max marks on compressor crankcase (curbside)
Approved Compressor Oils - R-134a:
Castrol: Icematic SW68C
Mobil: EAL Arctic 68
ICI: Emkarate RL68H

c. Thermostatic Expansion Valve:

Superheat Setting (Non-externally adjustable): 10 to 12°F
MOP Setting (Nonadjustable): 55 ±4 psig (3.74 ±2.27 bar)

d. High Pressure Switch (HPS):

Opens at: 300 ±10 psig (20.41 ±0.68bar)
Closes at: 200 ±10 psig (13.61 ±0.68bar)

e. Low Pressure Switch (LPS)

Opens at: 6 ±3psig (0.41 ±0.20 bar)
Closes at: 25 ±3 psig (1.7 ±0.20 bar)

1.4 ELECTRICAL SPECIFICATIONS - MOTORS

a. Evaporator Fan Motor

Evaporator Motor	ECDC*	Permanent Magnet	
	27.5 VDC	24 VDC	12 VDC
Horsepower (kW)	0.34(.25)	1/8 (.09)	
Full Load Amps (FLA)	8.4	9.5	19
Operating Speed High/Low (RPM)	4252/ 3165	4200/ 1850	
Bearing Lubrication	Factory Lubricated (additional grease not required)		

b. Condenser Fan Motor

Condenser Motor	ECDC*	Permanent Magnet	
	24 VDC	24 VDC	12 VDC
Horsepower (kW)	0.15(.11)	1/8 (.09)	
Full Load Amps (FLA)	7	9	18
Operating Speed High/Low (RPM)	4252/ NA	4200/ 1850	
Bearing Lubrication	Factory Lubricated (additional grease not required)		

* Electronically Communicated Direct Current

1.5 ELECTRICAL SPECIFICATIONS - SENSORS AND TRANSDUCERS

a. Suction and Discharge Pressure Transducer

Supply Voltage: 4.5 to 5.5 vdc (5 vdc nominal)
Supply current: 8 mA maximum
Output Range: 8K ohms minimum
Input Range: -6.7 to 450 psig (-0.46 to 30.62 bar)
Output Current: -1.5 mA minimum to 1.5 mA maximum
Output Voltage: vdc = 0.0098 x psig + 0.4659
(See Table 4-2 for calculations.)

b. Temperature Sensors

Input Range: -52.6 to 158°F (-47 to 70°C)
Output: NTC 10K ohms at 77°F (25°C)
(See Table 4-1 for calculations.)

1.6 SAFETY DEVICES

System components are protected from damage caused by unsafe operating conditions with safety devices. Safety devices with Carrier Transicold supplied equipment include high pressure switch (HPS), low pressure switch (LPS), circuit breakers and fuses.

a. Pressure Switches

High Pressure Switch (HPS)

During the A/C mode, compressor operation will automatically stop if the HPS switch contacts open due to an unsafe operating condition. Opening HPS contacts de-energizes, through the controller, the compressor clutch shutting down the compressor. The high pressure switch (HPS) is installed in the center head of the compressor.

Low Pressure Switch (LPS)

The low pressure switch is installed in the compressor and opens on a pressure drop to shut down the system when a low pressure condition occurs. In addition, if the control monitors a pressure less than 10 psig (0.68 bar)by the suction pressure transducer mounted in the evaporator section, the system will be shut down for at least one minute.

b. Fuses and Circuit Breakers

The Relay Board is protected against high current by an OEM supplied 150 amp fuse. Independent 15 amp circuit breakers protect each motor while the output circuits are protected by an additional 15 amp circuit breaker. During a high current condition, the breaker (or OEM fuse) may open. When power is removed from a device, a breaker alarm will be generated.

c. Ambient Lockout

The ambient temperature sensor located in the condenser section measures the condenser inlet air temperature. When the temperature is below the cut out set point the compressor is locked out until the temperature rises above the cut in setting. The set points may be programmed to cut out at 45°F 7.2°C) and cut in at 50°F 10°C) or cut out at 25 °F –3.9°C) and cut in at 45°F 7.2°C) in accordance with bus purchase specification. This setting protects the compressor from damage caused by operation at low pressures.

1.7 AIR FLOW

The paths for ambient air through the condenser and coach air through the evaporator are illustrated in Figure 1-5.

1.8 AIR CONDITIONING REFRIGERATION CYCLE

When air conditioning (cooling) is selected by the controller, the unit operates as a vapor compression system using R-134a as a refrigerant (see Figure 1-6). The main components of the system are the reciprocating compressor, air-cooled condenser coils, receiver, filter-drier, thermostatic expansion valve, liquid line solenoid valve and evaporator coils.

The compressor raises the pressure and the temperature of the refrigerant and forces it into the condenser tubes. The condenser fan circulates surrounding air (which is at a temperature lower than the refrigerant) over the outside of the condenser tubes. Heat transfer is established from the refrigerant (inside the tubes) to the condenser air (flowing over the tubes). The condenser tubes have fins designed to improve the transfer of heat from the refrigerant gas to the air; this removal of heat causes the refrigerant to liquefy, thus liquid refrigerant leaves the condenser and flows to the receiver.

The receiver serves as a liquid refrigerant reservoir so that a constant supply of liquid is available to the evaporators as needed, and acts as a storage space when pumping down the system. The receiver is equipped with sight glasses to observe the refrigerant for restricted flow and correct charge level.

The refrigerant leaves the receiver and passes through the receiver outlet/service valve, through a filter-drier where an absorbent keeps the refrigerant clean and dry.

From the filter-drier, the liquid refrigerant then flows through the liquid line solenoid valve to the thermostatic expansion valve. the thermal expansion valve reduce pressure and temperature of the liquid and meters the flow of liquid refrigerant to the evaporator to obtain maximum use of the evaporator heat transfer surface.

The low pressure, low temperature liquid that flows into the evaporator tubes is colder than the air that is circulated over the evaporator tubes by the evaporator fans (fans). Heat transfer is established from the evaporator air (flowing over the tubes) to the refrigerant (flowing inside the tubes). The evaporator tubes have aluminum fins to increase heat transfer from the air to the refrigerant; therefore the cooler air is circulated to the interior of the bus. Liquid line solenoid valve closes during shutdown to prevent refrigerant flow.

The transfer of heat from the air to the low temperature liquid refrigerant in the evaporator causes the liquid to vaporize. This low temperature, low pressure vapor passes through the suction line and returns to the compressor where the cycle repeats.

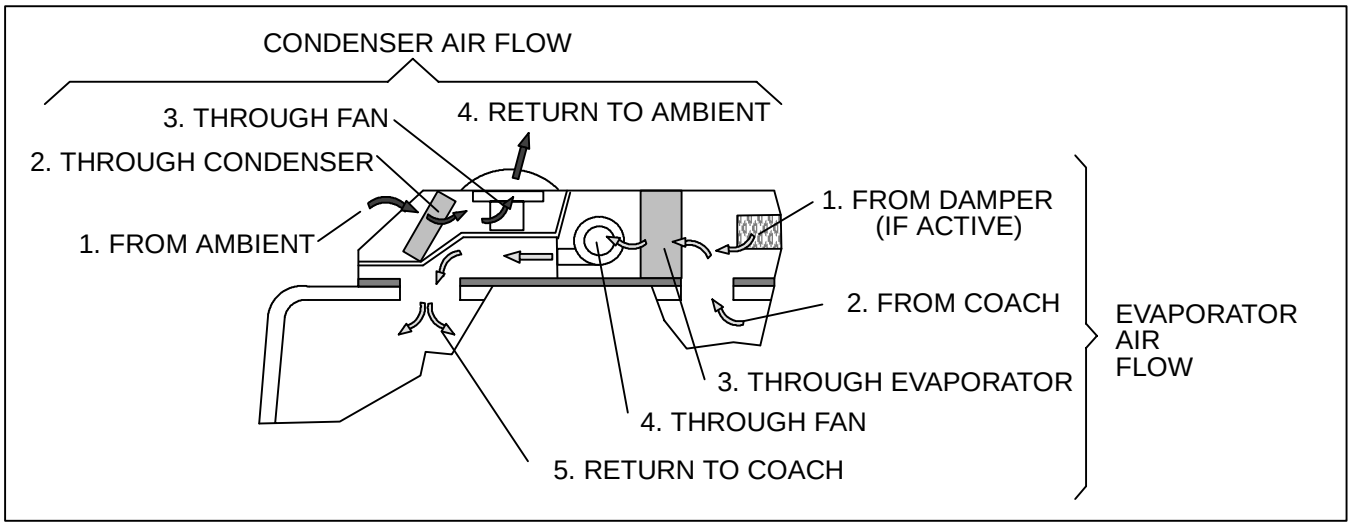
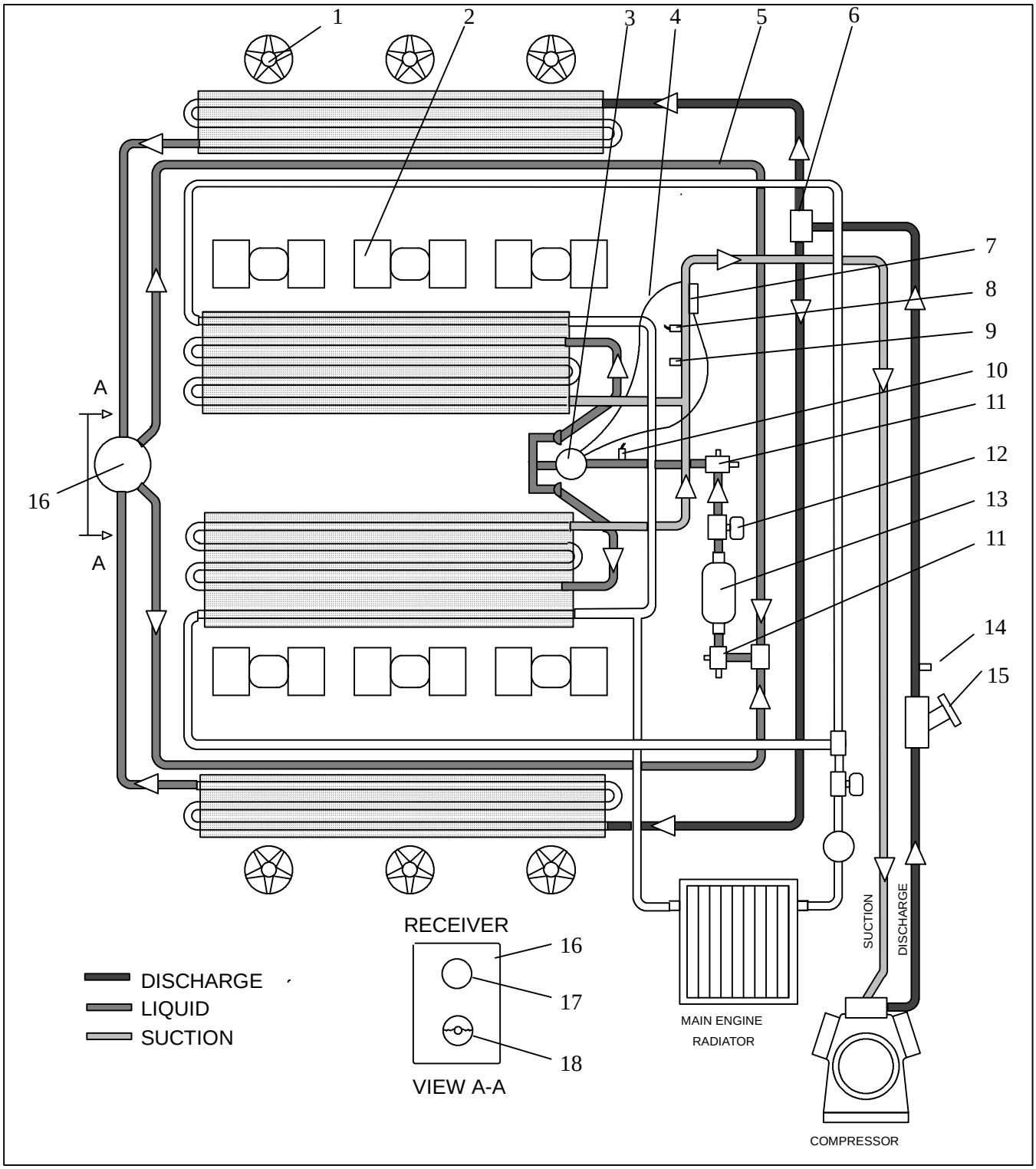


Figure 1-5. Air Flow Paths



1. Condenser Fan Assembly
2. Evaporator Fan Assembly
3. Expansion Valve
4. Expansion Valve Equalizer Line
5. Liquid Line
6. Precharge Valve
7. Expansion Valve Bulb
8. Pressure Transducer, Low Side
9. Service Port, Low Side
10. Pressure Transducer, High Side
11. Service Valve With Port
12. Liquid Line Solenoid Valve
13. Filter Drier
14. Service Port, High Side
15. Discharge Check Valve
16. Receiver
17. Refrigerant Sight Glass
18. Moisture Indicator

Figure 1-6. Refrigerant Flow Diagram
(GR60 Shown)

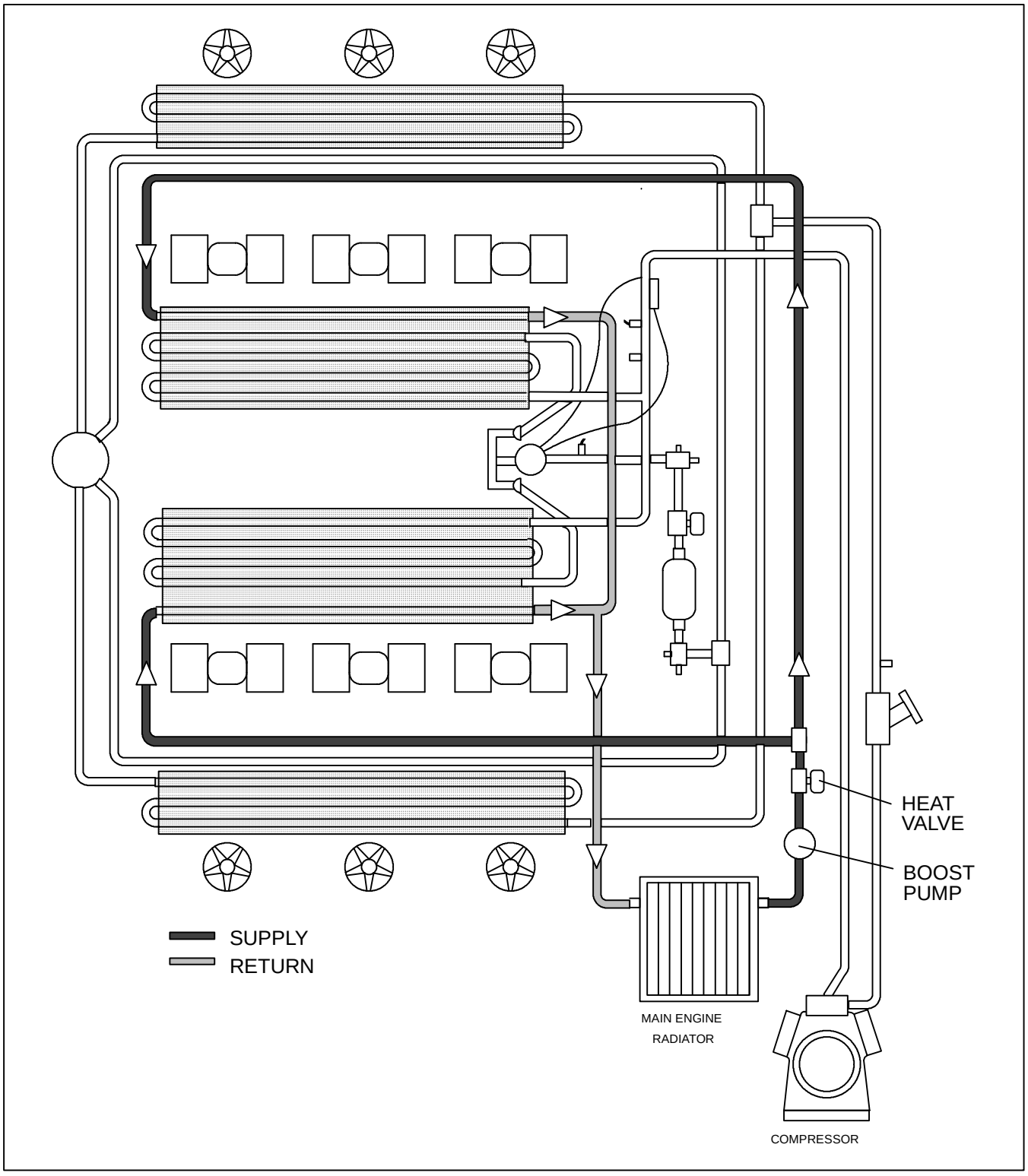


Figure 1-7. Heating Cycle Flow Diagram
(GR60 Shown)

1.9 HEATING CYCLE

Heating circuit (Figure 1-7) components furnished by Carrier Transicold include the integral evaporator coil heater cores and a solenoid operated heat valve. Components furnished by the bus manufacturer include auxiliary heater and boost water pump. The controller automatically controls the heat valve during the heating and reheat modes to maintain required temperatures inside the bus. Engine coolant (glycol solution) is circulated through the heating circuit by the engine and an auxiliary boost water pump. When the heat valve solenoid is energized, the valve will open to allow engine coolant to flow through the heater coil. The valve is normally closed so that if a failure occurs, the system will be able to cool.

1.10 RELAY BOARD

1.10.1 Permanent Magnet Motors with 2 speed switching from series to parallel connection (Option 1)

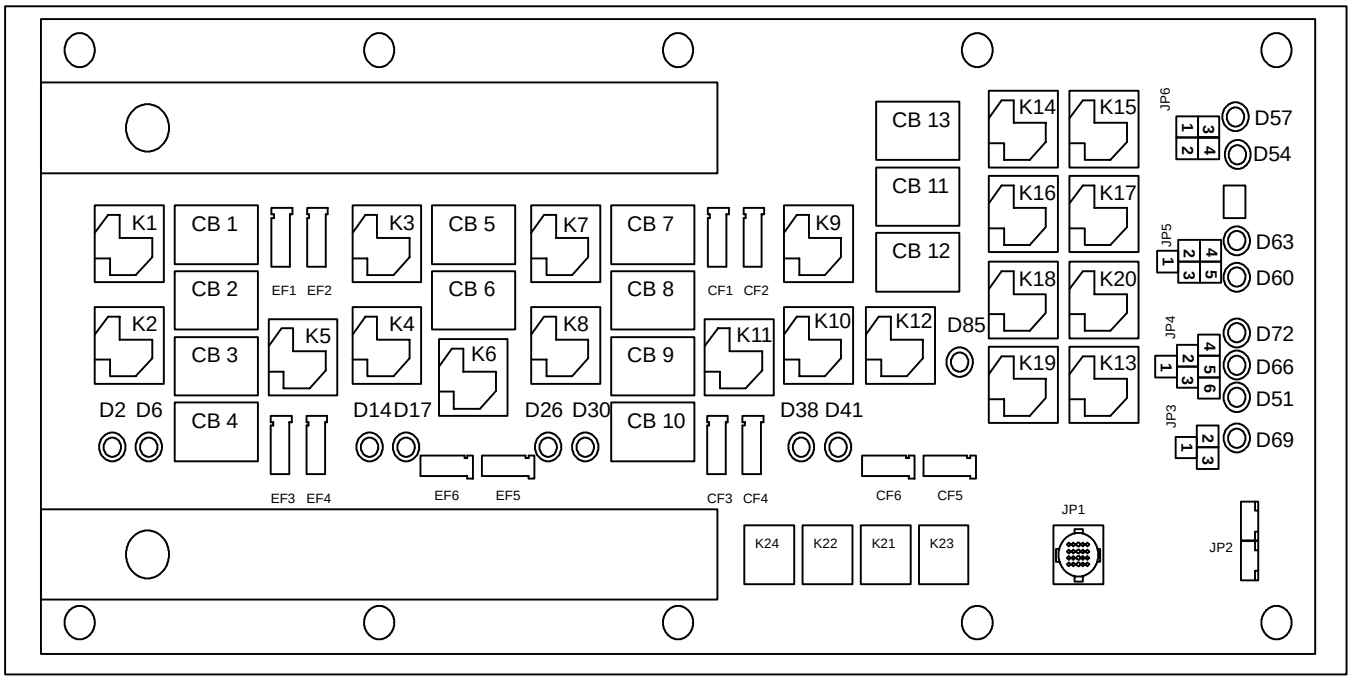


Figure 1-8 Relay Board (Option 1)

a. Relays

K1 Energizes evaporator fans 1 & 2 in high speed or evaporator fans 1,2,3 & 4 in low speed.

K2 Energizes evaporator fans 3 & 4 in high speed (not energized in low speed).

K3 Energizes evaporator fan 5 in high speed or evaporator fans 5 & 6 in low speed.

K4 Energizes evaporator fan 6 in high speed (not energized in low speed).

K5 Connects the negative side of evaporator fans 1 & 2 to ground in high speed. Connects the negative side of evaporator fans 1 & 2 to positive side of evaporator fans 3 & 4 in low speed

K6 Connects the negative side of evaporator fan 5 to ground in high speed. Connects the negative side of evaporator fan 5 to positive side of evaporator fan 6 in low speed

K 7 Energizes condenser fans 1 & 2 in high speed or condenser fans 1,2,3 & 4 in low speed

K 8 Energizes condenser fans 3 & 4 in high speed (not energized in low speed).

K 9 Energizes condenser fan 5 in high speed or condenser fans 5 & 6 in low speed.

K10 Energizes condenser fan 6 in high speed (not energized in low speed).

K11 Connects the negative side of condenser fans 1 & 2 to ground in high speed. Connects the negative side of condenser fans 1 & 2 to the positive side of condenser fans 3 & 4 in low speed.

K12 Connects the negative side of condenser fan 5 to ground in high speed. Connects the negative side of condenser fan 5 to the positive side of condenser fan 6 in low speed.

K13 Energizes the A/C clutch.

K14 Energizes unloader 1.

K15 Energizes unloader 2.

K16 Energizes the fresh air damper.

K17 Energizes the heat valve.

K18 Energizes the fault light output.

K19 Energizes the Boost Pump.

K20 Energizes the spare output.

K21 Is energized by the logic board to turn the evaporator fans on high. The contacts of this relay energize the coils of relays K1, K2, K3 & K4.

K22 Is energized by the logic board to turn the evaporator fans on low. The contacts of this relay energize the coils of relays K1, K3, K5 & K6.

K23 Is energized by the logic board to turn the condenser fans on high. The contacts of this relay energize the coils of relays K7, K8, K9 & K10.

K24 Is energized by the logic board to turn the condenser fans on low. The contacts of this relay energize the coils of relays K7, K9, K11 & K12.

b. Thermal Circuit Breakers

CB 1	Evaporator Fan #1.	15 Amp.
CB 2	Evaporator Fan #2.	15 Amp.
CB 3	Evaporator Fan #3.	15 Amp.
CB 4	Evaporator Fan #4.	15 Amp.
CB 5	Evaporator Fan #5.	15 Amp.
CB 6	Evaporator Fan #6.	15 Amp.
CB 7	Condenser Fan #1.	15 Amp.
CB 8	Condenser Fan #2.	15 Amp.
CB 9	Condenser Fan #3.	15 Amp.
CB10	Condenser Fan #4.	15 Amp.
CB11	Condenser Fan #5.	15 Amp.
CB12	Condenser Fan #6.	15 Amp.
CB13	A/C clutch, Unloaders 1&2, Fresh Air Damper, Heat Valve, Fault Output and Spare output.	15 Amp

c. Connectors

EF1-EF6 Evaporator fans.

CF1-CF4 Condenser fans.

JP1 External evaporator & condenser fan thermal overload connections.

JP2 Logic board connector.

JP3 Boost pump.

JP4 A/C clutch, fault output, compressor high pressure switch.

JP5 Spare output, fresh air output, heat valve.

JP6 Unloaders 1 & 2.

d. LEDS

D 2 Relay K1 output active (evaporator fans 1,2,3 & 4 energized)

D 6 Will be brightly lit if evaporator fans 1, 2, 3 & 4 are on high. Will be at half intensity of they are on low.

D14 Relay K3 output active (evaporator fans 5 & 6 energized).

D17 .Will be brightly lit if evaporator fans 5 &6 are on high. Will be at half intensity of they are on low.

D26 Relay K7 output active (condenser fans 1, 2, 3 & 4 energized).

D30 Will be brightly lit if condenser fans 1, 2, 3 & 4 are on high. Will be at half intensity of they are on low.

D38 Relay K9 output active (condenser fans 5 & 6 energized).

D41 Will be brightly lit if condenser fans 5 &6 are on high. Will be at half intensity of they are on low.

D51 A/C clutch output active.

D54 Unloader 1 output active.

D57 Unloader 2 output active.

D60 Fresh air output active.

D63 Heat valve output active.

D66 Fault output active.

D69 Boost pump output active.

D72 Spare output active.

1.10.2 Electronically Communtated DC Motors with 2-speed Evaporator Input Signal (Option 2)

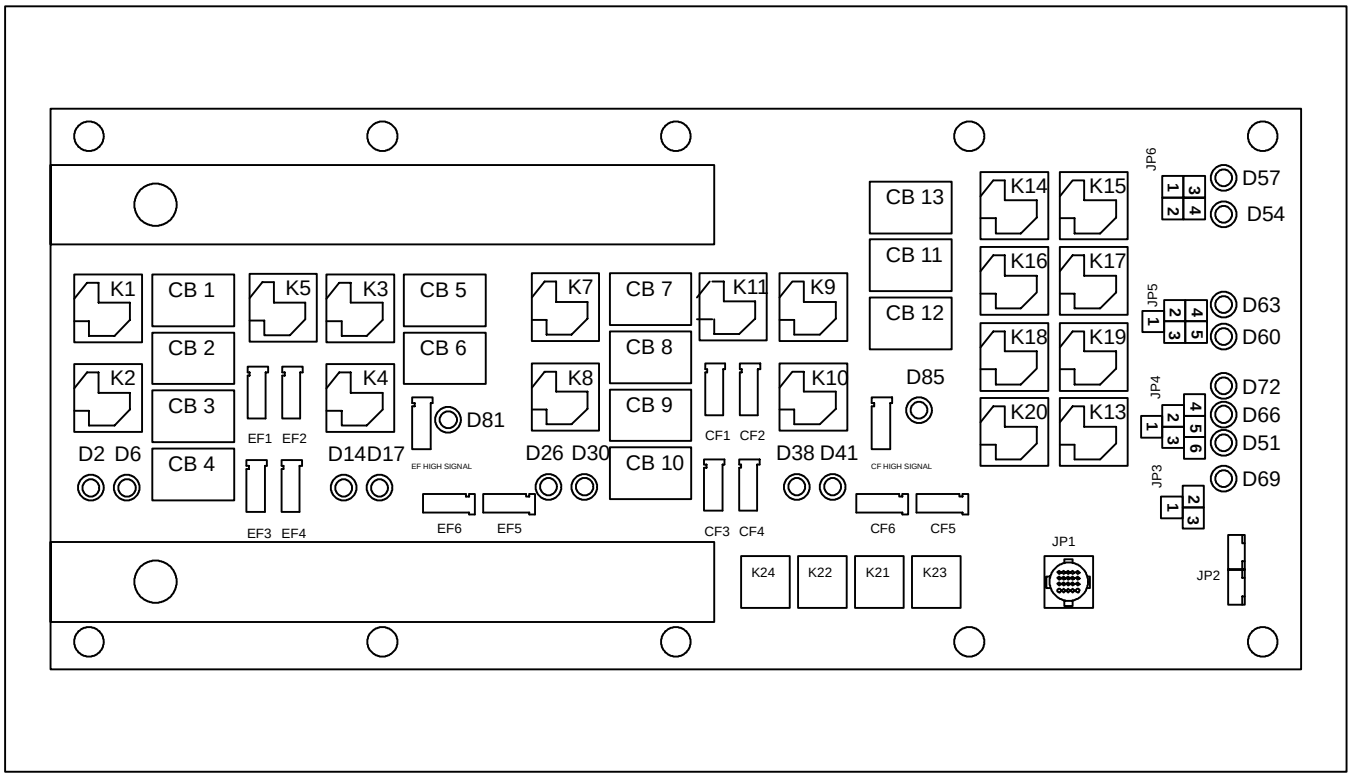


Figure 1-9 Relay Board (Option 2)

a Relays

K1 Energizes evaporator fans 1 & 2

K2 Energizes evaporator fans 3 & 4.

K3 Energizes evaporator fan 5.

K4 Energizes evaporator fan 6.

K5 Provides evaporator fan high output signal. (Motors are in low speed when K5 is de-energized)

K6 Not Used

K 7 Energizes condenser fans 1 & 2.

K 8 Energizes condenser fans 3 & 4.

K 9 Energizes condenser fan 5

K10 Energizes condenser fan 6.

K13 Energizes the A/C clutch.

K14 Energizes unloader 1.

K15 Energizes unloader 2.

K16 Energizes the fresh air damper.

K17 Energizes the heat .

K18 Energizes the fault light output.

K19 Energizes the Boost Pump.

K20 Energizes the spare output.

K21 or K22 Is energized by the logic board to turn the evaporator fans on. The contacts of these relays energize the coils of relays K1, K2, K3 & K4.

K23 or K24 Is energized by the logic board to turn the condenser fans on high. The contacts of these relays energize the coils of relays K7, K8, K9 & K10.

b Thermal Circuit Breakers

Refer to paragraph 1.10.1b.

c. Connectors

Refer to paragraph 1.10.1c.

EF HIGH SIGNAL Output to the evaporator fans to operate on high.

CF HIGH SIGNAL Output to the condenser fans to operate on high.

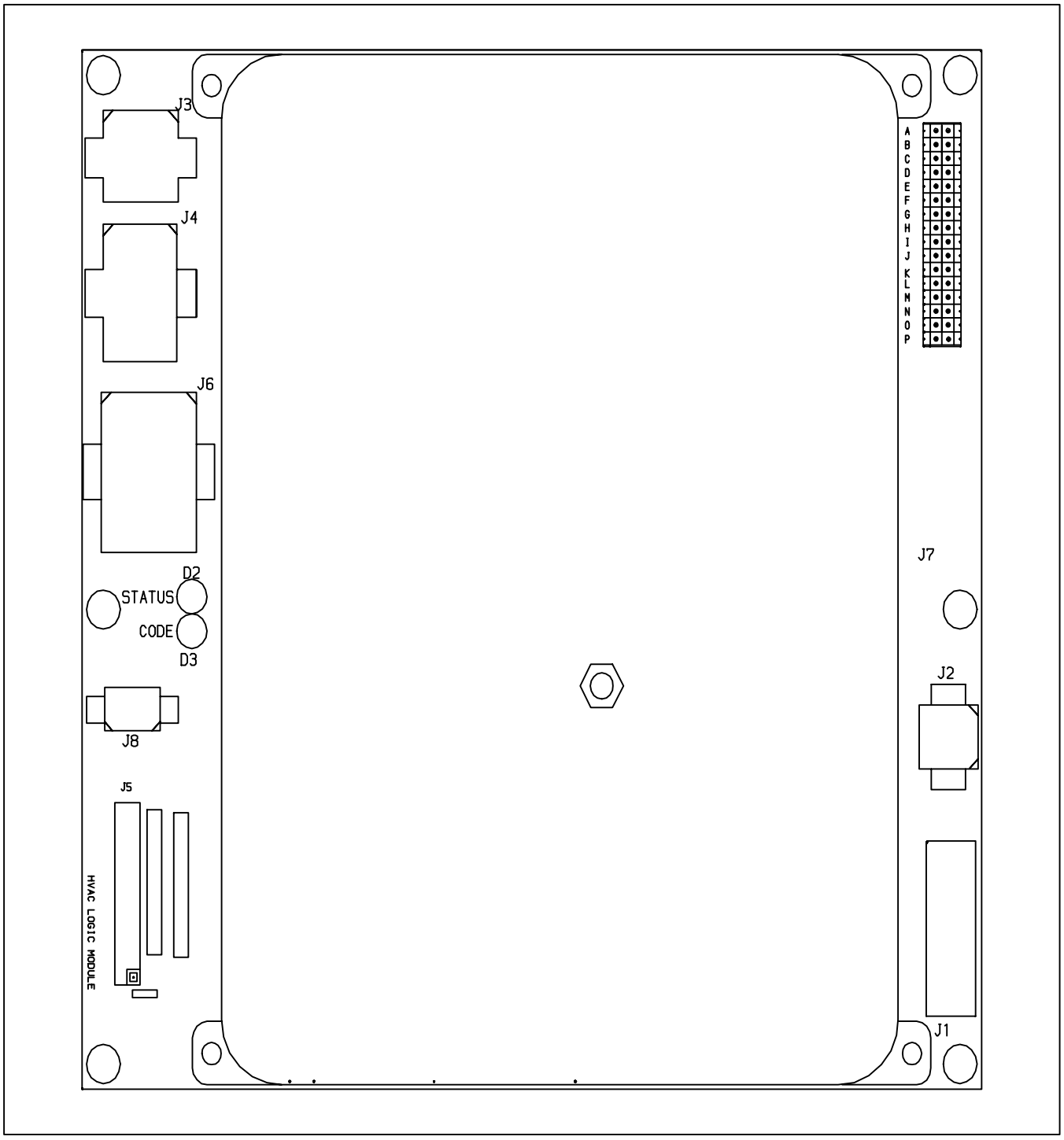
d. LEDS

Refer to paragraph 1.10.1d.

D81 Evaporator fans on high

D85 Condenser fans on high

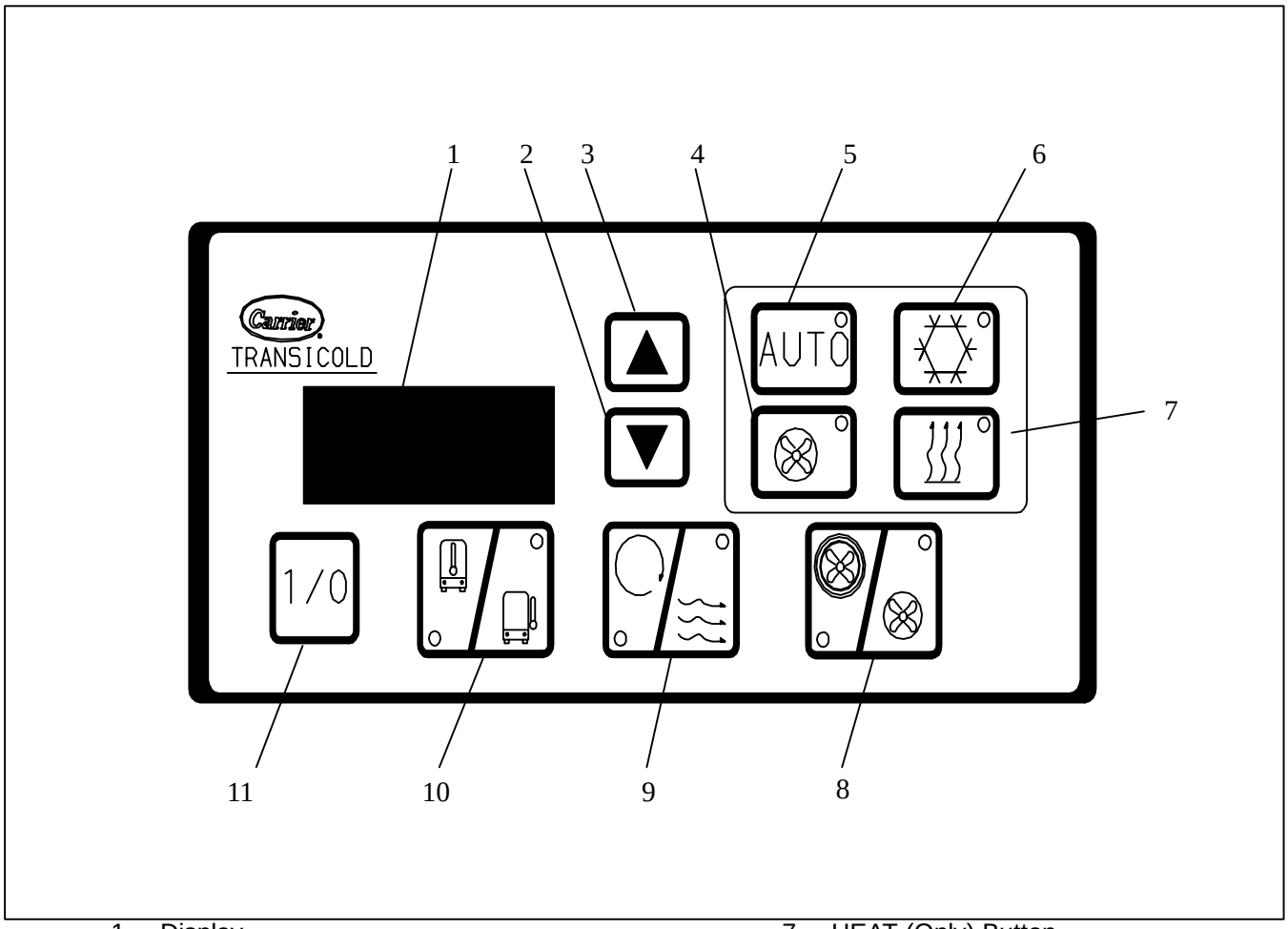
1.11 LOGIC BOARD



J1 Logic board power in.
J2 Display interface.
J3 Manual control inputs.
J4 Interlock Inputs (WTS, low side pressure switch etc.)
J5 Relay board interface.
J6 Sensor inputs (Thermistors, etc.).
J7 Diagnostics interface (RS232, DB9).
D2 Blinks once per second in normal operation. On steady to indicate alarms detected.
D3 Off In normal operation, blinks out alarm codes (2 digits each) when alarms detected.
A-P Configuration Jumpers

Figure 1-10 Logic Board

1.12 CONTROL PANEL (Diagnostic Module)



1. Display
2. DOWN Button – decrease selection
3. UP Button – increase selection
4. VENT (Only) Button
5. AUTO Button (Automatic Control)
6. COOLING (Only) Button
7. HEAT (Only) Button
8. FAN SPEED Button
9. FRESH AIR Button
10. TEMPERATURE (Inside / Outside) Button
11. ON/OFF Button

Figure 1-11. Micromate Control Panel

SECTION 2

OPERATION

2.1 STARTING, STOPPING AND OPERATING INSTRUCTIONS

2.1.1 Power to Logic Board

Before starting, electrical power must be available from the bus power supply. The system components receive power from two sources:

a. 24 vdc power for the microprocessor electronics is supplied through the bus multiplex module.

b. 24 vdc, 125 amp, power from a fuse in the battery compartment supplies power for the, clutch, compressor unloader solenoids, evaporator and condenser assemblies; this power is controlled by the Logic Board.

2.1.2 Starting

a. If the engine is not running, start the engine.

b. OEM SUPPLIED SWITCHES
Actual start sequence depends on the operating controls supplied. If only an ON/OFF switch is supplied, place the switch in the ON position to start the system in the automatic mode. If additional OEM switches are supplied, refer to the following Micromate control description for operating instructions.

c. MICROMATE CONTROL PANEL
It is suggested the system be started in the automatic mode.

1 The Micromate Control Panel Display (see Figure 1-11) may be programmed to display the set point temperature or return air temperature. To determine which display temperature is programmed, press the TEMPERATURE button so that the OUT SIDE AIR indicator is illuminated. If the controller cycles back to the INSIDE AIR indicator, than the controller is programmed to display return air temperature. If the controller does not automatically cycle back to the return air indicator, than the controller is programmed to display set point temperature.

2 To start the system, press the I/O button to illuminate the indicator light and signal the Logic Board to perform start up. Ensure the AUTO button indicator is illuminated. If not, press the AUTO button to place the system in the automatic mode. After the pre-trip inspection is completed, the switches may be set in accordance with the desired control modes.

3 If cooling only, heating only or ventilation only is desired, press the corresponding button (refer to Figure 1-11) to illuminate the indicator light and place the system in that mode of operation.

4 If low or high speed evaporator fan speed is desired, press the FAN SPEED button to illuminate the indicator light and bring speed to the desired level.

5 To open or close the fresh air damper, press the FRESH AIR button to illuminate the indicator light and bring the damper to the desired position.

6 To read interior or exterior temperature, press the TEMPERATURE button to illuminate the indicator light and bring the display to the desired temperature reading. After a short delay, the display will return to the default set point or return air temperature reading.

7 Setpoint may be changed by pressing the UP or DOWN arrow button. The UP button will increase the setpoint temperature and the DOWN button will decrease the setpoint temperature.

8 For additional Micromate operating data refer to paragraph 2.4.

2.1.3 Self-Test and Diagnostics (Check for Errors and/or Alarms)

Self-test of the main Logic Board electrical circuit is automatically initiated when the system is powered up. If there is an error in the circuit, an alarm will be indicated by flashing LED's on the Logic Board. If a Micromate is connected to the Logic Board, the error code can also be read on the display. If there are no errors in the circuit, system will operate normally and flash the status LED at a one second interval. During normal operation, the Logic Board monitors system operating parameters for out of tolerance conditions. If an out of tolerance condition occurs, *ALARM* will be indicated through the code LED or on the Micromate display. Refer to section 3 for definition of system errors and alarms and general troubleshooting procedures.

2.1.4 Stopping

Placing the ON/OFF switch in the OFF position or pressing the Micromate ON/OFF button will stop the system operation by removing power to the Logic Board.

2.2 PRE-TRIP INSPECTION

After starting system, allow system to stabilize for ten to fifteen minutes and check for the following:

a. Listen for abnormal noises in compressor or fan motors.

b. Check compressor oil level. (Refer to section 4.20.3)

c. Check refrigerant charge. (Refer to section 4.8.1)

d. Ensure that self-test has been successfully performed and that there are no errors or alarms indicated. (Refer to section 2.1.3.)

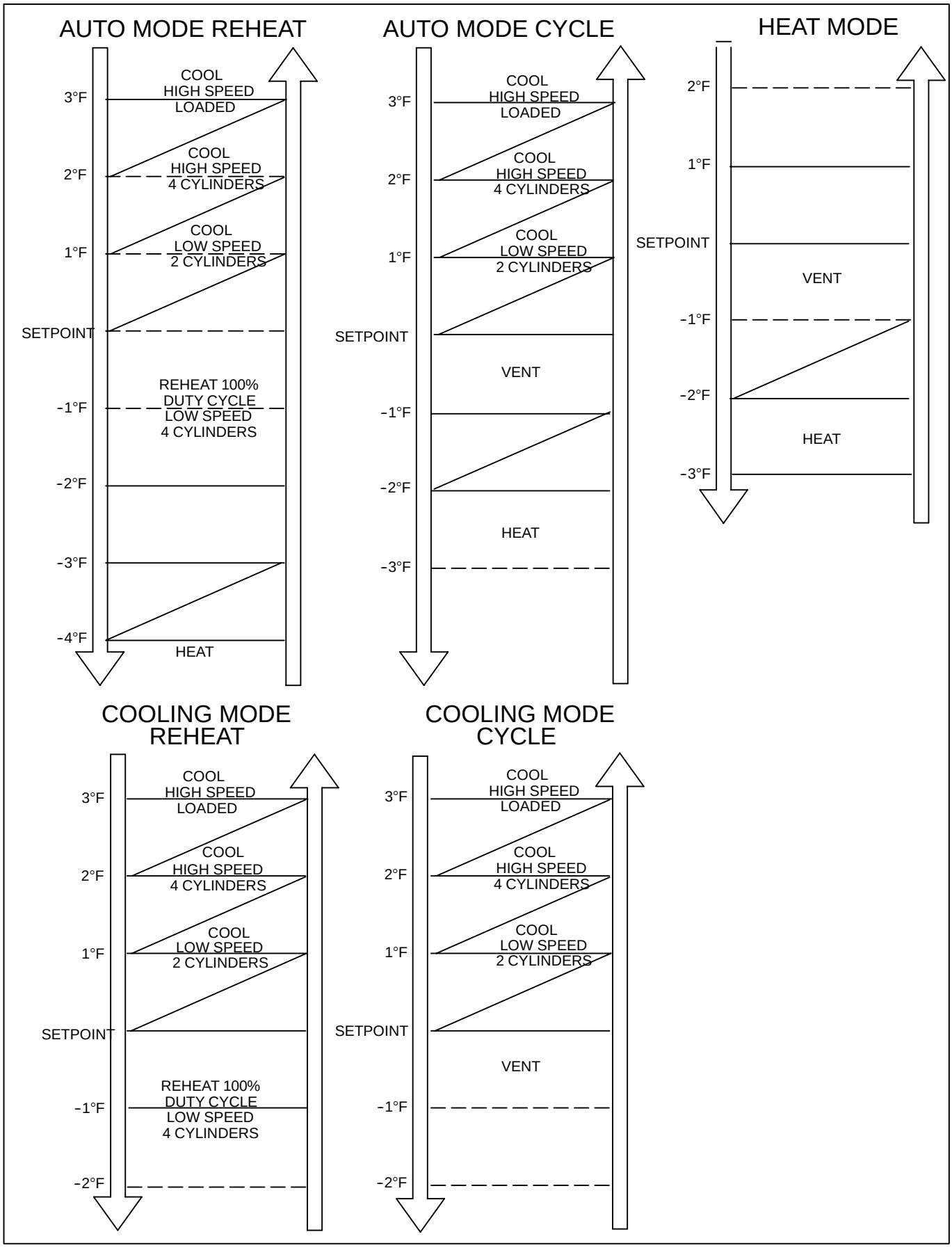


Figure 2-1 Capacity Control Diagram

2.3 MODES OF OPERATION

The system is operated by a Carrier Transicold Micromax microprocessor controller which consists of a logic board (Figure 1-10), relay board (Figure 1-8 or Figure 1-9), and manual operator switches. The logic board regulates operational cycles of the system by energizing or de-energizing Relay Board relays in response to deviations in interior temperature. Modes of operation include Cooling, Heat and Vent. Refer toFigure 2-1 and the following paragraphs for a description of each mode.

Figure 2-1 shows the Logic Board actions at various temperature deviations from setpoint. On rising temperature, changes occur when the temperature rises above Logic Board setpoints, On falling temperature, changes occur when temperatures falls below Logic Board set point. The system will operate in these modes unless pressures override the Logic Board settings.

2.3.1 Temperature Control

Temperature is controlled by maintaining the return air temperature measured at the return air grille.

2.3.2 Cooling Mode

Cooling is accomplished by energizing the compressor and condenser fans, opening the liquid line solenoid valve and closing the heating valve. Once interior temperature reaches the desired set point, the system may operate in the clutch cycle or reheat mode. Selection of clutch cycle or reheat is factory programmed in accordance with the bus purchase specification.

A controller programmed for clutch cycle will de-energize the compressor clutch and allow the system to operate in the vent mode until further cooling is required.

A controller programmed for reheat will maintain compressor operation and cycle the heat valve to allow reheating of the return air. In the reheat mode interior temperature is maintained at the desired set point while additional dehumidification takes place.

2.3.3 Heating Mode

In the heat mode the liquid line solenoid is closed and the compressor and condenser fans are shut down. The heat valve is opened to allow a flow of engine coolant through the heat section of the evaporator coil. The evaporator fans speed is varied as required to circulate air over the evaporator coil based on the temperature difference from setpoint.

Heating will not start until the water temperature switch (WTS) closes. The WTS is located on the block of the vehicle and is provided by the OEM. It senses the engine coolant temperature and closes on temperature rise at 105°F . The switch prevents the circulation of cooler air throughout the vehicle as the engine comes up to temperature.

2.3.4 Boost Pump

When the unit is in heat the boost pump relay is energized, providing 24 VDC to activate the boost pump.

2.3.5 Vent Mode

In the vent mode the evaporator fans are operated to circulate air in the bus interior.

2.3.6 Fresh Air System

The fresh air damper is opened to allow entrance of ambient air into the air entering the evaporator coil. The damper is operated by the controller to open when return air temperature is within +/-5°F (+/-2.8°C) of set point.

2.3.7 Compressor Unloader Control

When operating in cooling, the unloaders are used to reduce system capacity as return air temperature approaches set point. Operation of the unloaders balances system capacity with the load and thereby prevents overshoot from set point.

Relay Board mounted unloader outputs control the capacity of the compressor by energizing or de-energizing unloader solenoid valves. The model 05K (GR45) has two banks of two cylinders each while the model 05G compressor (GR60) has three banks of two cylinders each. Energizing a valve de-activates a bank of cylinders. The 05K right cylinder bank (looking at the pump end) and the outboard cylinder banks of the 05G are equipped with unloader valves (UV1 and, for the 05G, UV2), each controlling two cylinders; this allows the 05K to be operated with two or four cylinders and the 05G to be operated with two, four or six cylinders.

Whenever the compressor is started, the unloaders are energized for thirty seconds to reduce starting torque. After thirty seconds, unloaders may be de-energized. Any subsequent changes between energizing and de-energizing the unloaders for temperature control must be staged with a thirty second delay. Once an unloader is energized for pressure control, it remains energized for two seconds to prevent short cycling. Only one unloader may change state at a time when staging is required. Operating parameters for temperature control, suction pressure control and discharge pressure control are as follows.

a. Temperature Control

The unloaders are used to control system capacity by controlling compressor capacity.

1 Compressor Unloader UV1 Relay. When return air temperature falls to less than 2°F (1.1°C) above set point unloader UV1 is energized. If temperature rises to greater than 3°F (1.7°C) above set point, UV-1 will be de-energized to place the compressor at 100% capacity.

2 Compressor Unloader UV2 Relay. When return air temperature falls to less than 1°F (0.6°C) above set point unloader UV2 is energized. If temperature rises to greater than 2°F (1.1°C) above set point, UV-2 will be de-energized to place the compressor (GR60 only) at 66% capacity.

b. Suction Pressure

The unloaders are used to control suction pressure and thereby prevent coil frosting:

1 Compressor Unloader UV1 Relay. When the suction pressure decreases below 26 psig (1.77 bar), unloader UV1 is energized unloading a cylinder bank (two cylinders); this output will remain energized until the pressure increases to above 34 psig (2.31 bar).

2 Compressor Unloader UV2 Relay. When suction pressure decreases below 23 psig (1.56 bar) [on a GR60], unloader UV2 is energized unloading the second compressor cylinder bank; this output will remain energized until the pressure increases to above 31 psig (2.11 bar).

c. Discharge Pressure

Discharge pressure is also controlled by the unloaders:

1 Compressor Unloader UV1 Relay. When the discharge pressure increases above 275 psig (18.71 bar), unloader UV1 is energized; this output will remain energized until the pressure decreases below 220 psig (14.97 bar). Staging is ignored during discharge pressure override.

2 Compressor Unloader UV2 Relay. When the discharge pressure increases above 285 psig (19.39 bar),unloader UV2 is energized; this output will remain energized until the pressure decreases below 225 psig(15.31 bar).

2.3.8 Evaporator Fan Speed Selection

Temperature control is the primary method of determining the fan speed selection. The following table indicates relay operational status for the various fan motor states while Figure 2-1 provides Logic Board speed selections at various deviations form set point..

Table 2-1. Evaporator Fan Speed Relay Operation

STATE	HIGH SPEED RELAYS	EVAP FAN RELAY
Off	Off	Off
Low	Off	On
High	On	On

2.3.9 Condenser Fan Control

The condenser fans are energized when the compressor clutch output is energized. The fans are started in low speed and will remain in low speed until the discharge pressure increases to 225 psig (15.31 bar). The fans will remain in high speed until discharge pressure decreases below 190 psig (12.93 bar). The fans will also be activated if a high pressure alarm has been activated and operation has not been locked out (refer to Table 3-3).

2.3.10 Compressor Clutch Control

A belt driven electric clutch is employed to transmit engine power to the air conditioning compressor. De-energizing the clutch electric coil disengages the clutch and removes power from the compressor. The clutch will be engaged when in cooling and disengaged when the system is off, in heating or during high and low pressure conditions.

The clutch coil is prevented from engagement when the ambient temperature is below 45°F *(*7.2°C*)*.

The clutch coil will be de-energized if the discharge pressure rises to the 300 psig (20.41 bar) cutout setting of the compressor mounted high pressure switch. The clutch coil will energize when the discharge pressure falls to 200 psig (13.61 bar).

The clutch coil will be de-energized if the suction pressure decreases below 10 psig (0.68 bar).

2.3.11 Alarm Description

Alarm descriptions and troubleshooting procedures are provided in section 3.

2.3.12 Hour Meters

Hour meter readings are available in the parameter code list of the Micromate. The hour meters record the compressor run time and the total time the evaporator fans are on. The maximum hours is 999,999. Refer to paragraph 2.4.3 for instructions on reading parameter codes.

2.4 MICROPROCESSOR DIAGNOSTICS

The Micromate allows the user to interface with the microprocessor based control. This allows system parameters, alarms and settings to be viewed and modified. On systems with OEM supplied operating switches, a Micromate may be connected as a service tool using a special harness. The following instructions supplement those provided in paragraph 2.1.2. Once a Micromate is connected as a service tool, the following instructions are applicable.

2.4.1 Connecting

Connect the Micromate harness to the service port located in the return air section of the A/C system. When the Micromate is connected, the panel lights will be energized and the currently stored setpoint will be displayed. If any alarm is active, the reading will be *A##*, where *A* indicates that the alarm is active and *##* indicates the alarm number.

2.4.2 Control

NOTE

1 This procedure should be performed by an HVAC technician who has been trained on Carrier Model GR system design. Control configuration is preset by the manufacturer and resetting of the parameters should not be required. It is recommended that Carrier Service or Engineering is contacted before any control configuration is changed. Carrier can not be responsible for failures or damage resulting from unauthorized changes.

2 If a replacement Logic Module is installed, it is necessary to match the configuration jumpers (see Figure 1-10) to the original board. Refer to paragraph 4.24.

a. Turn the A/C main power switch (located in the driver's area) to OFF.

b. Connect the Micromate to the service port located in the return air section.

c. Unplug the logic board connector J3.

d. Turn the A/C main power switch back to the ON position.

e. Activate the system by pressing the 1/0 key on the Micromate panel.

NOTE

Be sure to reconnect J3 when testing is completed or the system will fail to operate when the Micromate is disconnected.

NOTE

When modifying the setpoint temperature for diagnostic purposes, be sure to reset the setpoint when testing is complete.

2.4.3 Diagnostic Mode

Diagnostic mode can be entered by pressing the up and down arrow keys simultaneously for 5 seconds. Diagnostic mode allows alarms and system parameters to be viewed. If there are any alarms stored, the most recent alarm will be shown. To view additional alarm information, refer to section 3. Press the up and down arrow keys to view parameters.

2.4.4 System Parameters

Pressing the up/down arrow keys will allow the user to scroll up or down through the parameters. If no key is pressed for 30 seconds this mode is exited and the display will revert back to the default display. Pressing the on/off key any time will exit this mode and the display will again indicate the default. The parameters are shown in Table 2-3. When scrolling through the parameters, the current parameter will be displayed for two seconds. After two seconds, the display will show the data for the current parameter. When the last parameter is reached, the list will wrap back to P1.

2.4.5 Test Mode

With the system in normal operation, the controller may be placed in the test mode, by doing the following:

a. Enter the diagnostic mode by pressing the up and down arrow keys simultaneously for 5 seconds. Enter the test mode by pressing the COOL key five times.

b. In the test mode, the display will read "T##" where "##" indicated the test number that is currently running.

c. The initial indication will be "T00". This indicates the controller is in the test mode and all relays are de–energized. Press the arrow keys to scroll through and perform each test When the highest test number is reached, the display will increment back to the lowest test number. A listing of tests is provided in Table 2-2.

d. To terminate testing, press the I/0 key.

Table 2-2. Controller Test List

TEST	OUTPUT	STATE
T00	All Relays	Off
T01	Evaporator High	On
T02	Evaporator Low	On
T03	Condenser High	On
T04	Condenser Low	On
T05	Compressor	On
T06	Unloader Valve 1	On
T07	Unloader Valve 2	On
T08	Fresh Air Damper	On
T09	Heat	On
T10	Fault	On
T11	Boost	On
T12	Spare/Motor Input	On

Table 2-3. Parameter Codes

CODE	CODE NAME	DESCRIPTION
P1	Return Air Temperature	This value is the temperature measured by the return air sensor. If the sensor is shorted it will display *CL*. If it is open circuited it will display *OP.*
P2	Coil Temperature	This value is the coil temperature measured by the evaporator temperature sensor. If the sensor is shorted it will display *CL*. If it is open circuited it will display *OP.*
P3	Ambient Temperature	This value is the outside temperature measured by the ambient temperature sensor. If the sensor is shorted it will display *CL*. If it is open circuited it will display *OP.*
P4	Suction Line Temperature	Not used.
P5	Suction Pressure	This value is the suction pressure measured by the suction pressure transducer. If the sensor is shorted it will display *CL* If it is open circuited it will display *OP.*
P6	Discharge Pressure	This value is the discharge pressure measured by the discharge pressure transducer. If the sensor is shorted it will display “CL” and if it is open circuited it will display “OP”.
P7	Superheat	Not used.
P8	Analog Set Point Temperature	Not used.
P9	A/C Control Window #1	This is the number of degrees F above setpoint at which the unloaders will be both energized. This value can be modified between 0 and 10 degrees F. The default value is 1 degree F.
P10	A/C Control Window #2	This is the number of degrees F above AC control window one at which the first unloader will be energized. This value can be modified between 0 and 10 degrees F. The default value is 1 degree F.
P11	A/C Control Window #3	This is the number of degrees F above AC control window two at which the evaporator fan speed will be set to low. This value can be modified between 0 and 10 degrees F. The default value is 1 degree F.
P12	Heat Control Window	This is the number of degrees F below setpoint before the heat valve is energized. This value can be modified between 0 and 10 degrees F. The default value is 2 degree F for heat and 4 degrees F for reheat.
P13	Compressor Safety Off Delay	This number is the minimum time in minutes that the compressor must be off after a high or low pressure alarm before it can be restarted. This value can be modified between one and five minutes. The default value is 1.
P14	Fan Delay	This is the minimum time (in seconds) that the fans must run at a particular speed before changing to another speed. This value can be modified between one and 60 seconds. The default value is two seconds.
P15	Unloader/Heat Valve Delay	This is the minimum time (in seconds) that the unloaders and heat valve must be in a particular state (open /closed) before changing to another state. This value can be modified between 1 and 60 seconds. The default value is 2 seconds.
P16	Compressor High Pressure Switch	This is the current state of the compressor high pressure switch input. “CL” will be displayed if it is closed and “OP” will be displayed if it is open.
P17	Condenser Fan Speed Switch	Not used.

Table 2-3. Parameter Codes – Continued

Code	Code Name	Description
P18	Maximum Setpoint	This is the maximum value that the operator will be allowed to set the setpoint temperature. The value can be modified in degrees with the up and down keys to a value between 60°F and 80°F.
P19	Minimum Setpoint	This is the minimum value that the operator will be allowed to set the setpoint temperature. The value can be modified in degrees with the up and down keys to a value between 60°F and 80°F.
P20	Compressor Hours High	This is the number of hours of operation that the compressor has run with the clutch energized in thousands
P21	Compressor Hours Low	This is the number of hours of operation that the compressor has run with the clutch energized in hundreds, tens and ones.
P22	Evaporator Hours High	This is the number (in thousands) of hours of operation with the evaporator fans energized.
P23	Evaporator Hours Low	This is the number (in hundreds, tens and ones) of hours of operation with the evaporator fans energized.
P24	Maintenance 1 Hour High	This is the value of compressor hours high (P20) at which maintenance alarm #1 will be activated. This value can be modified by the up and down arrow keys. If both high and low values are zero the alarm is disabled.
P25	Maintenance 1 Hour Low	This is the value of compressor hours low (P21) at which maintenance alarm #1 will be activated. This value can be modified by the up and down arrow keys. If both high and low values are zero the alarm is disabled.
P26	Maintenance 2 Hours High	This is the value of evaporator fan hours high (P22) at which maintenance alarm #2 will be activated. This value can be modified by the up and down arrow keys. If both high and low values are zero the alarm is disabled.
P27	Maintenance 2 Hours Low	This is the value of evaporator fan hours low (P23) at which maintenance alarm #2 will be activated. This value can be modified by the up and down arrow keys. If both high and low values are zero the alarm is disabled.
P28	Freeze Alarm Setting	This is the value at which the freeze alarm will be activated. The default value is 32°F. This value can be modified between 20°F and 40°F in one degree increments by using the arrow keys
P29	Relay Module Voltage	This is the voltage being supplied to the relay module.
P30	Main Board Software Version	This is the software version of the logic board.
P31	Display Software Version	This is the software version of the display module.
P32	Ki	Not used.
P33	Kp	Not used.
P34	Default Display	This is the value displayed on the Micromate control panel. It is set to OFF to display set point temperature or set to ON to display return air temperature. This feature is available in software revision 1.9 and later.
P33 to P34	Not Defined	Not used. These codes will show in software revision 1.9 and later.

SECTION 3

TROUBLESHOOTING

CAUTION

Do not under any circumstances attempt to service the microprocessor. should a problem develop with the microprocessor, replace it.

3.1 SELF DIAGNOSTICS

A self test is performed by the Micromax Logic Board each time the board is powered up. Errors, if any, will be indicated and the unit will not be allowed to start. The error codes can be read by counting the number of times that the Logic Board STATUS and CODE LED's (see Figure 1-10) flash simultaneously. The Micromate display will indicate errors with the code ER-#, where "ER" is the error prefix and # is the error number.

Table 3-1 Error Codes

CODE	NAME	DESCRIPTION
ER 1	Data Memory	Logic board data memory failure.
ER 2	Program Memory	Logic board program memory failure.
ER 3	A/D	A/D and multiplexer failure.
ER 4	Communication Failure	Failure in communication between the logic board and MDST.
ER 5	Program Memory	Display program memory failure.

3.2 SYSTEM ALARMS

3.2.1 Alarm Codes

The Micromax Logic Board continuously monitors system parameters and will generate an ALARM if a parameter exceeds preset limits. Alarms are indicated and the controller will respond in accordance with the information provided in Table 3-2. The alarm codes can be read by counting the number of times that the Logic Board CODE LED (see Figure 1-10) flashes. Each alarm code is a two digit number, the first set of flashes is the first digit and (after a slight pause) the second set of flashes is the second digit. The Micromate display will indicate alarms with the code A-## or i-##, where "A" is an active alarm prefix, "i" is an inactive alarm prefix and ## is the error number. If multiple alarms are present the user can scroll through each alarm by pressing the ARROW keys. When the end of the alarm list is reached the display will show "---". If the auto key is held down for five seconds while "---" is displayed all inactive alarms are cleared. A listing of alarm codes is provided in Table 3-2.

3.2.2 Activation

When alarms are detected, they are placed in an alarm queue in the order at which they initiated unless the alarm is already present. Each alarm recorded will also capture an evaporator hour meter reading corresponding to the activation time. If the AUTO key is pressed while an alarm is displayed, the activation time capture will be shown.

3.2.3 Alarm Queue

The alarm queue consist of 10 alarm locations. When the alarm queue is full the Logic Board will take the required action but the alarm will not be recorded. When this situation occurs, an "Alarm Queue Full"alarm will be generated. When the alarms are viewed this will be the first alarm to be shown.

3.2.4 Alarm Clear

The user may clear inactive alarms using the Micromate keypad. Refer to paragraph 3.2.1.

3.3 TROUBLESHOOTING

General procedures for system troubleshooting are provided in Table 3-3

Table 3-2 Alarm Codes

ALARM NO.	TITLE	CAUSE	REMEDY	CONTROLLER RESPONSE
A11	Coil Freeze	Coil temperature is less than 32°F and the compressor is operating.	Check causes of coil freezing. (Refer to section 3.3.6)	An alarm will be generated and the system will shutdown. The evaporator fans will remain running while the compressor is off.
A12	High Voltage	The battery voltage is greater than 32 volts.	Check, repair or replace alternator.	The system is shut down until the voltage returns to normal levels.
A13	Low Voltage	The battery voltage is less than 17 volts.	Check, repair or replace wiring or alternator.	The system is shut down until the voltage returns to normal levels.
A14	Return Air Probe Failure	Return air temperature sensor failure or wiring defective.	Ensure all connectors are plugged in. Check sensor resistance or wiring. Refer to paragraph 4.21. Replace sensor or repair wiring.	All outputs except the evaporator fans will be de-energized.
A15	Suction Pressure Transducer Failure	Suction pressure transducer failure or wiring defective.	Ensure all connectors are plugged in. Check sensor voltage or wiring. Replace sensor or repair wiring.	Both unloaders are energized.
A16	Discharge Pressure Transducer Failure	Discharge pressure transducer failure or wiring defective.	Ensure all connectors are plugged in. Check sensor voltage or wiring. Replace sensor or repair wiring.	One unloader is energized.
A17	Low Pressure Shutdown	Low suction pressure switch open or wiring defective.	Check cause of low suction pressure. (Refer to section 3.5.3)	The clutch is de-energized for the minimum off time. The evaporator fans will remain running during this period. After the compressor cycles off three times in 30 minutes all outputs will be de-energized and the system is locked out until the power is cycled or the alarm is reset.
A21	High Discharge Pressure	High discharge pressure switch open or wiring defective.	Check discharge pressure transducer reading, wiring or cause of high discharge pressure. (Refer to section 3.3.3)	The clutch is de-energized for the minimum off time. The condenser and evaporator fans will remain running during this period. After the compressor cycles off three times in 30 minutes all outputs will be de-energized and the system is locked out until the power is cycled or the alarm is reset.

Table 3-2 Alarm Codes – Continued

ALARM NO	TITLE	CAUSE	REMEDY	CONTROLLER RESPONSE
A22	Breaker Trip Alarm	A breaker on the relay board has tripped or a fan relay has failed.	Check breakers for tripped device. Repair short and reset breaker.	Alarm will be generated.
A23	Evaporator Fan Overload	Evaporator fan overload jumper is open.	Ensure connector is plugged in or repair wiring.	Alarm will be generated.
A24	Condenser Fan Overload	Condenser fan overload jumper is open.	Ensure connector is plugged in or repair wiring.	Alarm will be generated.
A25	Motor Failure	A brushless motor has not reached full operating speed or a motor failure.	Replace motor, or correct pressure shutdown.	Alarm displayed and the motor fail output is energized.
A26	Not used			
A31	Maintenance Alarm 1	The compressor hour meter is greater than the value in Maintenance Hour Meter 1.	Reset the maintenance hour meter.	Alarm will be generated.
A32	Maintenance Alarm 2	The evaporator hour meter is greater than the value in Maintenance Hour Meter 2.	Reset the maintenance hour meter.	Alarm will be generated.
A99	Alarm Queue Full	All locations of the alarm queue are currently full and no more alarms can be saved.	Record and clear alarm queue.	Alarm will be generated.

Table 3-3 General System Troubleshooting Procedures

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3.1 System Will Not Cool		
Compressor will not run	Active system alarm V-Belt loose or defective Clutch coil defective Clutch malfunction Compressor malfunction	3.2 Check Check/Replace Check/Replace See Table 1-2.
Electrical malfunction	Coach power source defective Circuit Breaker/safety device open	Check/Repair Check/Reset
3.3.2 System Runs But Has Insufficient Cooling		
Compressor	V-Belt loose or defective Compressor valves defective	Check See Table 1-2.
Refrigeration system	Abnormal pressures No or restricted evaporator air flow Expansion valve malfunction Restricted refrigerant flow Low refrigerant charge Service valves partially closed Safety device open Liquid solenoid valve stuck closed	3.3.3 3.3.6 3.3.7 4.11 4.8 Open 1.6 Check
Restricted air flow	No evaporator air flow or restriction	3.3.6
Heating system	Heat valve stuck open	3.3.8
3.3.3 Abnormal Pressures		
High discharge pressure	Discharge transducer failure Refrigerant overcharge Noncondensable in system Condenser motor failure Condenser coil dirty	Replace 4.8.1 Check Check Clean
Low discharge pressure	Discharge transducer failure Compressor valve(s) worn or broken Low refrigerant charge	See Note. See Table 1-2. 4.8
High suction pressure	Compressor valve(s) worn or broken	See Table 1-2.
Low suction pressure	Suction service valve partially closed Filter-drier inlet valve partially closed Filter-drier partially plugged Low refrigerant charge Expansion valve malfunction Restricted air flow Suction transducer failure	Open Check/Open 4.11 4.8 3.3.7 3.3.6 Replace
Suction and discharge pressures tend to equalize when system is operating	Compressor valve defective	See Table 1-2.
3.3.4 Abnormal Noise Or Vibrations		
Compressor	Loose mounting hardware Worn bearings Worn or broken valves Liquid slugging Insufficient oil Clutch loose, rubbing or is defective V-belt cracked, worn or loose Dirt or debris on fan blades	Check/Tighten See Table 1-2. SeeTable 1-2. 3.3.7 4.20.3 Check Check/Adjust Clean

Table 3-3 General System Troubleshooting Procedures – Continued

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3.4 Abnormal Noise Or Vibrations – Continued		
Condenser or evaporator fans	Loose mounting hardware Defective bearings Blade interference Blade missing or broken	Check/Tighten Replace Check Check/Replace
3.3.5 Control System Malfunction		
Will not control	Sensor or transducer defective Relay(s) defective Microprocessor controller malfunction Logic Board J3 connector unplugged	4.21 or 4.22 Check Check
3.3.6 No Evaporator Air Flow Or Restricted Air Flow		
Air flow through coil blocked	Coil frosted over Dirty coil Dirty filter	Defrost coil Clean Clean/Replace
No or partial evaporator air flow	Motor(s) defective Motor brushes defective Evaporator fan loose or defective Fan damaged Return air filter dirty Icing of coil Fan relay(s) defective Safety device open Fan rotation incorrect	Repair/Replace Replace Repair/Replace Repair/Replace Clean/Replace Clean/Defrost Check/Replace 1.6 Check
3.3.7 Expansion Valve Malfunction		
Low suction pressure with high superheat	Low refrigerant charge Wax, oil or dirt plugging valve orifice Ice formation at valve seat Power assembly failure Loss of bulb charge Broken capillary tube	4.8 Check 4.6 Replace Replace 4.19
Low superheat and liquid slugging in the compressor	Bulb is loose or not installed. Superheat setting too low Ice or other foreign material holding valve open	4.19 4.19
Side to side temperature difference (Warm Coil)	Wax, oil or dirt plugging valve orifice Ice formation at valve seat Power assembly failure Loss of bulb charge Broken capillary	Check 4.7 Replace Replace 4.19
3.3.8 Heating Malfunction		
Insufficient heating	Dirty or plugged heater core Coolant solenoid valve(s) malfunctioning or plugged Low coolant level Strainer(s) plugged Hand valve(s) closed Water pumps defective Auxiliary Heater malfunctioning.	Clean Check/Replace Check Clean Open Repair/Replace Repair/Replace
No Heating	Coolant solenoid valve(s) malfunctioning or plugged Controller malfunction Pump(s) malfunctioning Safety device open	Check/Replace Replace Repair/Replace 1.6
Continuous Heating	Coolant solenoid valve stuck open	Replace

SECTION 4

SERVICE

WARNING

BE SURE TO OBSERVE WARNINGS LISTED IN THE SAFETY SUMMARY IN THE FRONT OF THIS MANUAL BEFORE PERFORMING MAINTENANCE ON THE HVAC SYSTEM

NOTE

Following completion of all maintenance or service activities, the alarm queue should be cleared of any original alarms and any alarms generated during service. Refer to paragraph 3.2.1

4.1 MAINTENANCE SCHEDULE

SYSTEM ON	SYSTEM OFF	SYSTEM	REFERENCE SECTION
a. Daily Maintenance			
X		Pre-trip Inspection – after starting	2.2
	X	Check tension and condition of V-belt	None
b. Weekly Inspection			
	X	Perform daily inspection	See above
	X	Check condenser, evaporator coils and air filters for cleanliness	None
	X	Check refrigerant hoses and compressor shaft seal for leaks	4.6
X		Feel filter-drier for excessive temperature drop across drier	4.11
c. Monthly Inspection and Maintenance			
	X	Perform weekly inspection and maintenance	See above
	X	Clean evaporator drain pans and hoses	None
	X	Check wire harnesses for chafing and loose terminals	Replace/Tighten
	X	Check fan motor bearings	None
	X	Check compressor mounting bolts for tightness	None
	X	Check fan motor brushes	None

4.2 OPENING TOP COVER

To open the top cover, push in on the latches and pull forward as the cover is lifted . (See Figure 4-1.)

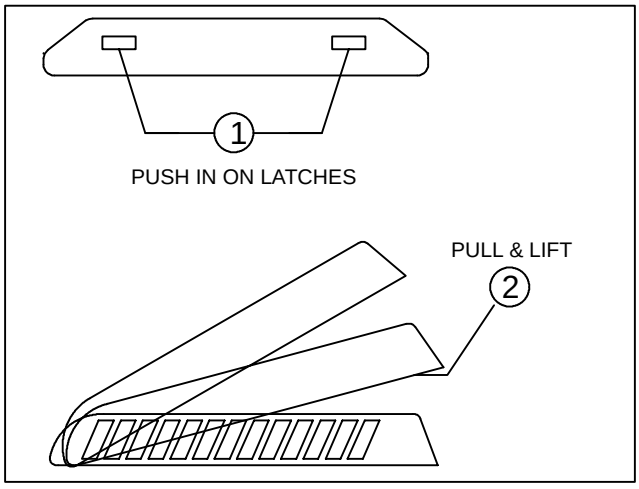


Figure 4-1. Opening Top Cover

4.3 SUCTION AND DISCHARGE SERVICE VALVES

The suction and discharge service valves (Figure 4-2) are provided with a double seat and a gauge port, which allows servicing of the compressor and refrigerant lines.

Turning the valve stem counterclockwise (all the way out) will *backseat* the valve to open the line to the compressor and close off the gauge port. In normal operation, the valve is backseated to allow full flow through the valve. The valve should always be backseated before removing the gauge port cap.

Turning the valve stem clockwise (all the way forward) will *frontseat* the valve to isolate the compressor line and open the gauge port.

To measure suction or discharge pressure, midseat the valve by opening the valve clockwise 1/4 to 1/2 turn. With the valve stem midway between frontseated and backseated positions, the suction or discharge gauge port is open to both the compressor and the line.

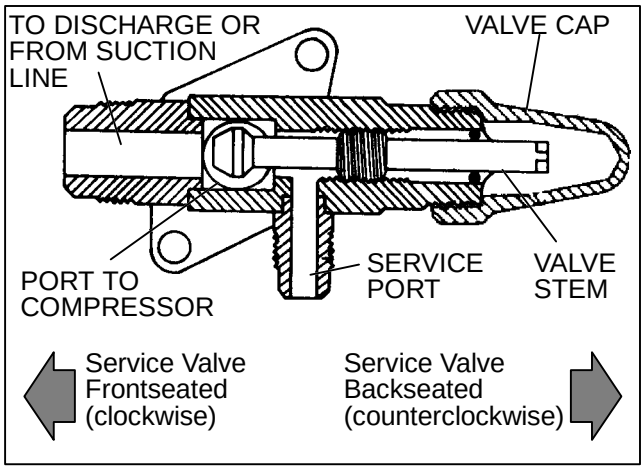
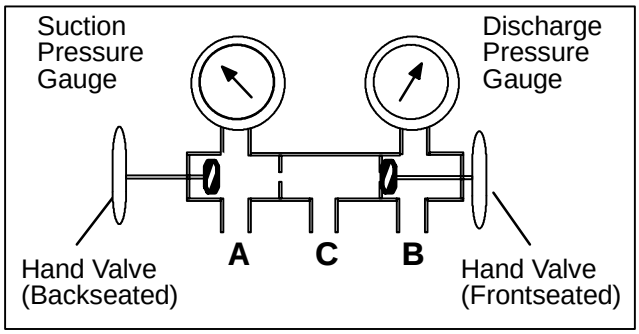


Figure 4-2.Suction or Discharge Service Valve

4.4 INSTALLING MANIFOLD GAUGE SET

A manifold gauge set (Figure 4-3) can be used to determine system operating pressures, add charge, equalize or evacuate the system.



A. Connection to Low Side of System
B. Connection to High Side of System
C. Connection to Vacuum Pump, Refrigerant Cylinder, Oil Container or Evacuation Line

Figure 4-3. Manifold Gauge Set

When the suction pressure hand valve is frontseated (turned all the way in), the suction (low) pressure can be read. When the discharge pressure hand valve is frontseated, discharge (high) pressure can be read. When both valves are open (turned counterclockwise), high pressure vapor will flow into the low side. When only the low pressure valve is open, the system can be charged or evacuated. To install a manifold gauge set, do the following (refer to Figure 4-4, Figure 4-5 or Figure 4-6 as applicable).

a. Remove the service valve stem caps and backseat (counterclockwise) both valves. Remove the service port caps.

b. Connect the discharge side hose *tightly* to the service valve port.

c. Connect the suction side hose *loosely* to the other service valve port.

d. Loosen charging (center) hose at dummy fitting of manifold set.

e. Frontseat (clockwise) both manifold gauge hand valves.

f. Turn the service valve connected to the discharge gauge port toward frontseat (clockwise) approximately 1/4 to 1/2 turn.

g. Slowly turn the manifold discharge hand valve toward backseat (counterclockwise) approximately one turn.

h. Tighten charging hose onto dummy fitting.

i. Slowly turn the manifold suction hand valve toward backseat (counter-clockwise) to remove air from line.

j. Tighten suction hose at the service valve port.

k. Frontseat (close) both manifold hand valves.

l. Turn the service valve connected to the suction gauge port toward frontseat (clockwise) approximately 1/4 to 1/2 turn.

4.5 PUMPING THE SYSTEM DOWN OR REMOVING THE REFRIGERANT CHARGE

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant.

4.5.1 System Pump Down For Low Side Repair

To service or replace the filter-drier, thermostatic expansion valve, suction line or evaporator coils, pump the refrigerant to the condenser and receiver as follows:

a. Install manifold gauge set. Refer to Figure 4-4

b. Frontseat the filter-drier inlet service valve by turning clockwise. Disconnect suction pressure transducer and install a jumper on the compressor mounted low pressure switch.

c. Start the system and run in cooling. Stop the unit when suction reaches 10 "/hg (25.4 cm/hg) vacuum.

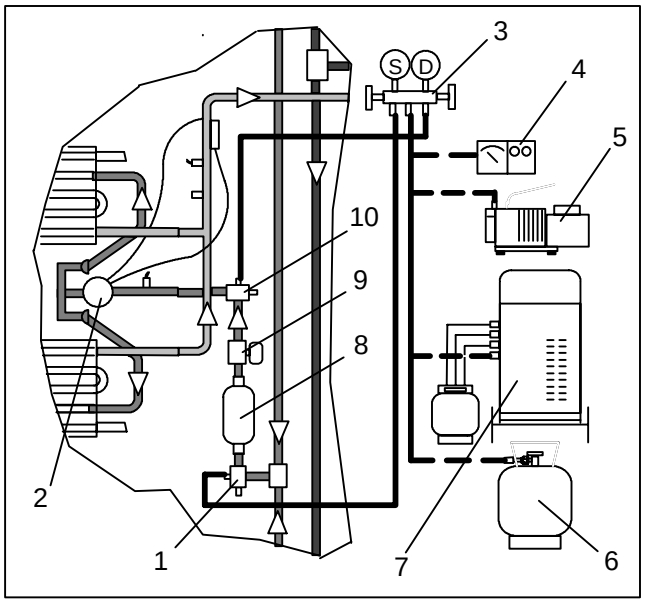
d. Frontseat compressor suction service valve to trap refrigerant in the high side of the system between the compressor suction service valve and the filter-drier inlet valve. Wait 5 minutes to verify that system remains in a vacuum. If system pressure rises above vacuum, open compressor suction service valve and repeat steps c and d until system remains in vacuum.

e. Service or replace necessary components.

f. Leak check connections and replace filter-drier. Refer to paragraph 4.6.

g. Using refrigerant hoses designed for vacuum service, evacuate and dehydrate the low side of the system by connecting a vacuum pump to center connection of manifold gauge set. Evacuate system to 500 microns. Close off pump valve, isolate vacuum gauge and stop pump. Wait 5 minutes to verify that vacuum holds.

h. Recharge low side to 20 to 30 psig (1.36 to 2.04 bar) by admitting vapor from the refrigerant cylinder.



1. Filter-Drier Inlet Service Valve
2. Thermostatic Expansion Valve
3. Manifold Gauge Set
4. Thermistor Vacuum Gauge
5. Vacuum Pump
6. Refrigerant Cylinder
7. Reclaimer
8. Filter-Drier
9. Liquid Solenoid Valve
10. Filter-Drier Outlet Service Valve

Figure 4-4. Low Side Pump Down Connections

i. Re-connect suction pressure transducer and remove low pressure switch jumper. If required, clear any alarms that have been generated during this procedure.

j. Open service valves and check refrigerant level. Refer to paragraph 4.8.1.

4.5.2 Refrigerant Removal From An Inoperative Compressor.

To remove the refrigerant from a compressor that is not operational, do the following:

a. Attach a manifold gauge set as shown in Figure 4-5 and isolate the compressor by frontseating the suction and discharge valves.

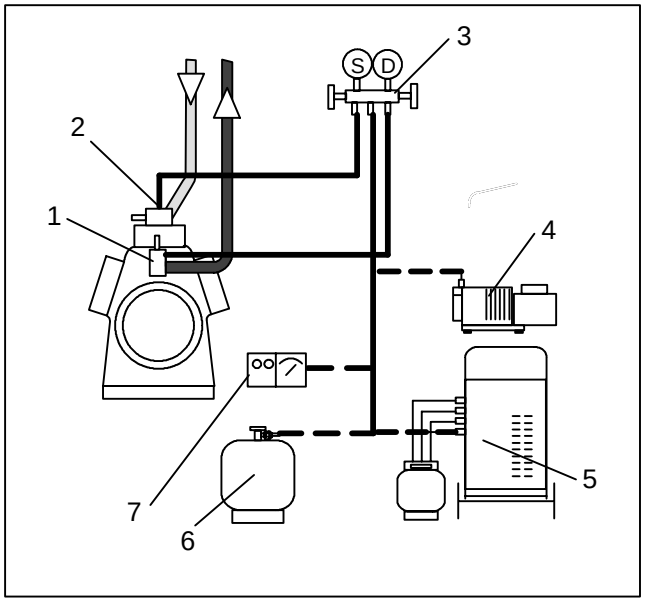
b. Recover refrigerant with a refrigerant reclaimer. If the discharge service valve port is not accessible, it will be necessary to recover refrigerant through the suction service valve port only.

c. Service or replace components as required and leak check the compressor.

d. Using refrigerant hoses designed for vacuum service, connect a vacuum pump to center connection of manifold gauge set. Evacuate system to 500 microns. Close off pump valve, isolate vacuum gauge and stop pump. Wait 5 minutes to verify that vacuum holds.

e. Once vacuum is maintained, recharge low side to 20 to 30 psig (1.36 to 2.04 bar) by admitting vapor from the refrigerant cylinder. Disconnect manifold gauge set and backseat compressor service valves.

f. Check refrigerant level. Refer to paragraph 4.8.1. It may be necessary to clear any alarms that have been generated.



1. Discharge Service Valve and Port
2. Suction Service Valve and Port
3. Manifold Gauge Set
4. Vacuum Pump
5. Reclaimer
6. Refrigerant Cylinder
7. Thermistor Vacuum Gauge

Figure 4-5. Compressor Service Connections

4.5.3 Pump Down An Operable Compressor For Repair

To service an operable compressor, pump the refrigerant into the condenser coil and receiver as follows:

a. Install manifold gauge set. Refer to Figure 4-5.

b. Frontseat the compressor suction service valve by turning clockwise.

c. Place a jumper on the low pressure switch. Start the unit and run in cooling until 10 ”/hg (25.4 cm/hg) of vacuum is reached. Shut the system down.

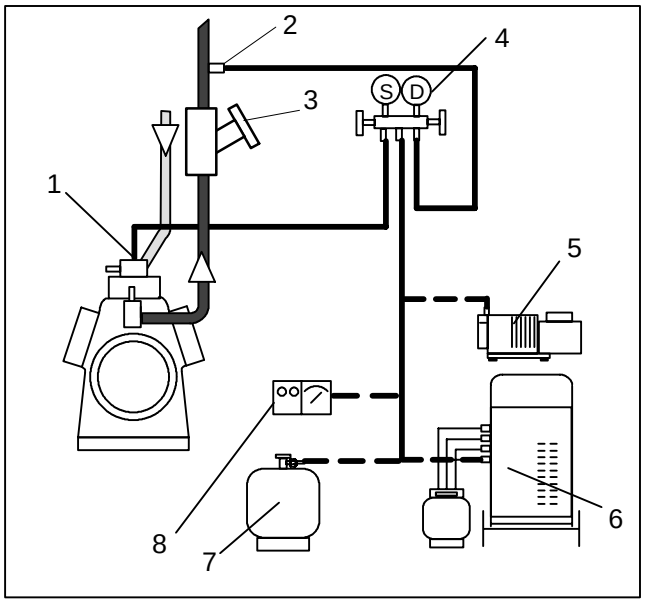
d. Frontseat the compressor discharge service valve and wait 5 minutes to verify vacuum is maintained. If the pressure rises above vacuum, open the compressor discharge service valve and repeat steps c and d until a vacuum is maintained.

e. Service or replace components as required and leak check the compressor.

f. Using refrigerant hoses designed for vacuum service, connect a vacuum pump to center connection of manifold gauge set. Evacuate system to 500 microns. Close off pump valve, isolate vacuum gauge and stop pump. Wait 5 minutes to verify that vacuum holds.

g. Once vacuum is maintained, re-connect low pressure switch, disconnect manifold gauge set and open compressor service valves.

h. Check refrigerant level. Refer to paragraph 4.8.1. It may be necessary to clear any alarms that have been generated.



1. Suction Service Valve and Port
2. Discharge Line Service Port
3 Check Valve
4. Manifold Gauge Set
5. Vacuum Pump
6. Reclaimer
7. Refrigerant Cylinder
8. Thermistor Vacuum Gauge

Figure 4-6. System Charge Removal Connections

4.5.4. Removing Entire System Charge

To remove the entire refrigerant charge, do the following:

a. Connect a manifold gauge set to the system as shown in Figure 4-6.

b. Connect a reclaimer to the center manifold gauge set connection.

c. Recover refrigerant in accordance with reclaimer manufacturers instructions.

4.6 REFRIGERANT LEAK CHECK

A refrigerant leak check should always be performed after the system has been opened to replace or repair a component.

To check for leaks in the refrigeration system, perform the following procedure:

NOTE

It must be emphasized that only the correct refrigerant should be used to pressurize the system. Use of any other refrigerant will contaminate the system, and require additional evacuation.

a. Ensure the liquid line service and solenoid valves are open.

b. If system is without refrigerant, charge system with refrigerant vapor to build up pressure between 20 to 30 psig (1.36 to 2.04 bar).

c. Add sufficient nitrogen to raise system pressure to 150 to 200 psig *(10.21 to 13.61 bar).*

d. Check for leaks. The recommended procedure for finding leaks in a system is with an electronic leak detector. Testing joints with soapsuds is satisfactory only for locating large leaks.

e. Remove test gas and replace filter–drier.

f. Evacuate and dehydrate the system. (Refer to paragraph 4.7.)

g. Charge the unit. (Refer to paragraph 4.8.)

h. Ensure that a Logic Board self-test has been performed and that there are no errors or alarms indicated. (Refer to paragraph 2.1.3.)

4.7 EVACUATION AND DEHYDRATION

4.7.1 General

The presence of moisture in a refrigeration system can have many undesirable effects. The most common are copper plating, acid sludge formation, “freezing-up” of metering devices by free water, and formation of acids, resulting in metal corrosion.

4.7.2 Preparation

NOTE

Using a compound gauge for determination of vacuum level is not recommended because of its inherent inaccuracy.

a. Evacuate and dehydrate only after pressure leak test. (Refer to paragraph 4.6)

b. Essential tools to properly evacuate and dehydrate any system include a good vacuum pump with a minimum of 5 cfm *(8.5 m^3/hr)* volume displacement, (CTD P/N 07-00176-01), and a good vacuum indicator (available through Robinair Manufacturing, Montpelier, Ohio, Part Number 14010).

c. Keep the ambient temperature above 60°F *(15.6°C)* to speed evaporation of moisture. If ambient temperature is lower than 60°F *(15.6°C),* ice may form before moisture removal is complete.

4.7.3 Procedure for Evacuation and Dehydrating System

a. Remove refrigerant using a refrigerant recovery system. Refer to paragraph 4.5.4

b. The recommended method is connecting lines (3/8” OD copper tubing or refrigerant hoses designed for vacuum service) as shown in Figure 4-6.

c. Make sure vacuum pump valve is open.

d. Start vacuum pump. Slowly open valves halfway and then open vacuum gauge valve.

e. Evacuate unit until vacuum gauge indicates 1500 microns Hg vacuum. Close gauge valve, vacuum pump valve, and stop vacuum pump.

f. Break the vacuum with clean dry refrigerant. Use refrigerant that the unit calls for. Raise system pressure to approximately 2 psig *(0.14 bar).*

g. Remove refrigerant using a refrigerant recovery system.

h. Start vacuum pump and open all valves. Dehydrate unit to 500 microns Hg vacuum.

i. Close off pump valve, and stop pump. Wait five minutes to see if vacuum holds.

j. Charge system. Refer to paragraph 4.8.2

4.8 ADDING REFRIGERANT TO SYSTEM

4.8.1 Checking Refrigerant Charge

The following conditions must be met to accurately check the refrigerant charge.

a. Coach engine operating at high idle.

b. Unit operating in cool mode for 15 minutes.

c. Head pressure at least 150 psig *(10.21 bar)*. (It may be necessary to block condenser air flow to raise head pressure.)

d. Under the above conditions, the system is properly charged when the refrigerant liquid level is at 1/2 to 3/4 of the lower receiver sight glass. If it is not at the proper level, add or remove refrigerant to bring it to the proper level. *Refrigerant level should not appear in the upper sight glass, as this would indicate an overcharge.*

4.8.2 Adding Full Charge

a. Install manifold gauge set at the compressor suction service valve and service port above the discharge line check valve. See figure Figure 4-6.

b. Evacuate and dehydrate system. (Refer to paragraph 4.7)

c. Place appropriate refrigerant cylinder on scales. Prepare to charge liquid refrigerant by connect charging hose from container to center connection on gage manifold . Purge air from hoses.

d. Note weight of refrigerant and cylinder.

e. Open cylinder valve, backseat discharge valve on gauge manifold and allow liquid refrigerant to flow into the high side of the system

f. When correct charge has been added, refer to paragraph 1.3, close cylinder valve and frontseat manifold discharge valve. At this point, the high side of the system has been charged but the low side is still in a vacuum because the liquid line solenoid is normally closed.

g. Prepare the cylinder as required to allow vapor charging. Backseat the manifold suction valve and charge vapor to build 20 to 30 psig (1.36 to 2.04 bar) pressure on the manifold suction gauge. Close cylinder valve and frontseat suction manifold set.

h. Check charge level in accordance with the procedures of paragraph 4.8.1.

4.8.3 Adding Partial Charge

a. Install manifold gauge set at the compressor suction service valve and service port above the discharge line check valve. See figure Figure 4-6.

b. Place appropriate refrigerant cylinder on scales. Prepare to charge vapor refrigerant by connecting charging hose from container to center connection on gauge manifold . Purge air from hoses.

c. Run unit in cool mode for 15 minutes. With suction service valve midseated open cylinder valve and add vapor charge until refrigerant level appears in the lower receiver sight glass. Under the above conditions, the system is properly charged when the refrigerant liquid level is at 1/2 to 3/4 of the lower receiver sight glass. If it is not at the proper level, add or remove refrigerant to bring it to the proper level. *Refrigerant level should not appear in the upper sight glass, as this would indicate an overcharge.*

d. Backseat suction service valve. Close vapor valve on refrigerant drum and note weight. Remove manifold gauge set and replace all valve caps.

4.9 CHECKING FOR NONCONDENSIBLES

To check for noncondensibles, proceed as follows:

a. Stabilize system to equalize pressure between the suction and discharge side of the system.

b. Check temperature at the condenser and receiver.

c. Check pressure at the compressor discharge service valve.

d. Check saturation pressure as it corresponds to the condenser/receiver temperature using the Temperature-Pressure Chart, Table 4-4.

e. If gauge reading is 3 psig *(0.20 bar)* or more than the saturation pressure in step d, noncondensibles are present.

f. Remove refrigerant using a refrigerant recovery system.

g. Evacuate and dehydrate the system. (Refer to paragraph 4.7.)

h. Charge the unit. (Refer to paragraph 4.8.2.)

4.10 CHECKING AND REPLACING HIGH PRESSURE SWITCH

WARNING

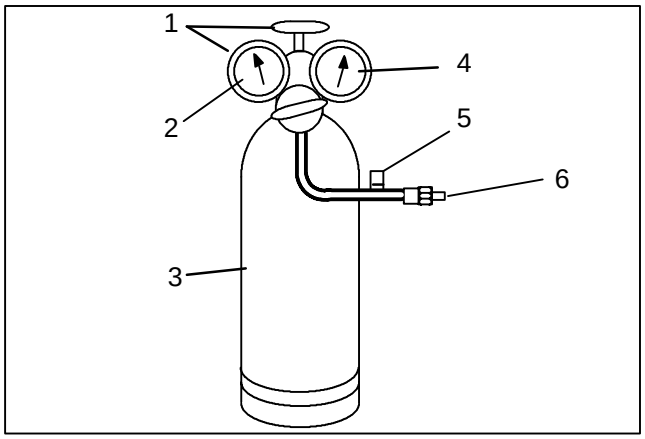
DO NOT USE A NITROGEN CYLINDER WITHOUT A PRESSURE REGULATOR

WARNING

DO NOT USE OXYGEN IN OR NEAR A REFRIGERATION SYSTEM AS AN EXPLOSION MAY OCCUR.

a. Disconnect wiring and remove switch from unit. All units are equipped with a schrader valve at the high pressure switch connection.

b. Connect switch to a cylinder of dry nitrogen. (See Figure 4-7.)



1. Cylinder Valve and Gauge
2. Pressure Regulator
3. Nitrogen Cylinder
4. Pressure Gauge (0 to 400 psig = 0 to 27.22 bar)
5. Bleed-Off Valve
6. 1/4 inch Connection

Figure 4-7. Checking High Pressure Switch

c. Connect an ohmmeter across switch terminals.

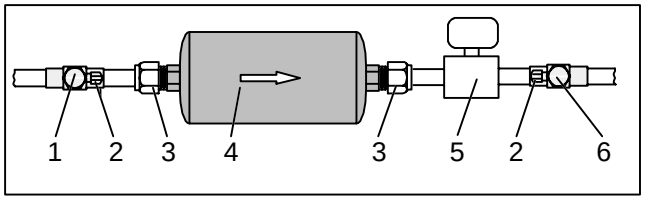
d. Set nitrogen pressure regulator higher than switch cutout setting. (refer to paragraph 1.3.)

e. Close cylinder valve and open bleed–off valve. Open cylinder valve and slowly close bleed–off valve. The switch should open, (no continuity) with in required cut out tolerance.

f. Close cylinder valve and release pressure through the bleed-off valve. As pressure drops, switch should close, (continuity) within required cut in tolerance.

g. Replace or re–install switch (as required) and reconnect wiring.

4.11 FILTER-DRIER



1. Filter-Drier Inlet Service Valve
2. Valve Service Port
3. Flare Nut
4. Filter-Drier
5. Liquid Line Solenoid Valve
6. Filter-Drier Outlet Service Valve

Figure 4-8. Filter–Drier Removal

4.11.1 To Check Filter–Drier

The filter–drier (see Figure 4-8) must be changed if the receiver mounted moisture indicator shows high moisture content or the drier is partially restricted. Check for a restriction by feeling the inlet and outlet lines of the filter–drier. If the outlet side feels cooler than the inlet side, then the filter–drier should be changed

4.11.2 To Replace Filter–Drier

a. Perform a low side pump down. Refer to paragraph 4.5.1.

b. Turn the driver's A/C switch to "OFF" position.

c. Frontseat the filter–drier outlet service valve and place a new filter-drier near the unit for immediate installation.

WARNING

THE FILTER-DRIER MAY CONTAIN LIQUID REFRIGERANT. SLOWLY LOOSEN THE FLARE NUTS AND AVOID CONTACT WITH EXPOSED SKIN OR EYES.

d. Using two open end wrenches, slowly crack open the flare nuts on each side of the filter-drier. Remove the filter-drier.

e. Remove seal caps from the new filter-drier. Apply a light coat of compressor oil to the flares.

f. Assemble the new filter-drier to lines ensuring that the arrow on the body of the filter-drier points in the direction of the refrigerant flow (refrigerant flows from the receiver to the evaporator). Finger tighten flare nuts.

g. Tighten filter-drier flare nuts using two open end wrenches.

h. Evacuate the filter–drier and lines by connecting a vacuum pump as shown in Figure 4-4. Evacuate to 500 microns.

i. Backseat (fully close) both service valve ports and replace valve caps.

j. Test filter-drier for leaks.

k. Check refrigerant level.

4.12 CONDENSER COIL REPLACEMENT

a. Place the driver's A/C switch in the OFF position and tag to prevent unintentional starting.

b. Remove the refrigerant charge. Refer to paragraph 4.5.4.

c. Remove the connection access covers to gain access to the mounting screws. Remove the mounting screws in the connection compartment and at the rear of the unit next to the receiver supports.

d. Remove the filter–drier mounting screws and remove the filter–drier. Disconnect the discharge hose.

e. Begin to lift the coil assembly at the left rear. Lift to clear the service valve then push to the right to clear the precharge valve. Continue to lift towards the front to clear the sight glasses and remove from the unit.

f. To install the coil assembly, reverse the removal procedure.

4.13 EVAPORATOR COIL REPLACEMENT

a. If refrigerant remains in the system, perform a low side pump down to remove refrigerant from the evaporator coils.

CAUTION

If unit was recently operated, be careful of remaining hot coolant in the hoses when disassembling.

b. Remove fresh air intake.

c. Drain heater coil by removing the required coolant from the engine cooling system.

d. Remove 12 mounting screws, 4 each at the receiver support, at the front of the unit and at the return air opening.

e. Remove the electronic board and harness.

f. Remove the filter-drier.

g. Disconnect suction line hose and lift coil out of unit.

h. To install the coil assembly, reverse the removal procedure.

4.14 SERVICING THE HEAT VALVE

The heat valve (Figure 4-9) requires no maintenance unless a malfunction to the internal parts or coil occurs. This may be caused by foreign material such as: dirt, scale, or sludge in the coolant system, or improper voltage to the coil.

There are only three possible valve malfunctions: coil burnout, failure to open, or failure to close.

Coil burnout may be caused by the following:

1 Improper voltage.

2 Continuous over-voltage, more than 10% or Undervoltage of more than 15%.

3. Incomplete magnetic circuit due to the omission of the coil housing or plunger.

4. Mechanical interference with movement of plunger which may be caused by a deformed enclosing tube.

Failure to open may be caused by the following:

1 Coil burned out or an open circuit to coil connections.

2 Improper voltage.

3 Torn diaphragm.

4 Defective plunger or deformed valve body assembly.

Failure to close may be caused by the following:

1 Defective plunger or deformed valve body assembly.

2 Foreign material in the valve.

3 Torn diaphragm.

4.14.1 Coil Replacement

a. It is not necessary to drain the coolant from the system.

b. Place main battery disconnect switch in OFF position and lock.

c. Disconnect wire leads to coil.

d. Remove coil retaining screw and nameplate.

e. Lift burned-out coil from enclosing tube and replace.

f. Connect wire leads and test operation.

4.14.2 Internal Part Replacement

a. Place main battery disconnect switch in OFF position and lock.

b. Open the vent fitting at the top of the outlet header of the heater coil.

c. Drain coil by opening the drain-cock on the inlet tube.

d. Disassemble valve and replace defective parts.

e. Assemble valve, refill and bleed coolant lines.

4.14.3 Replace Entire Valve

a. Place main battery disconnect switch in OFF position and lock.

b. Drain coolant from lines as previously described and disconnect hoses to valve .

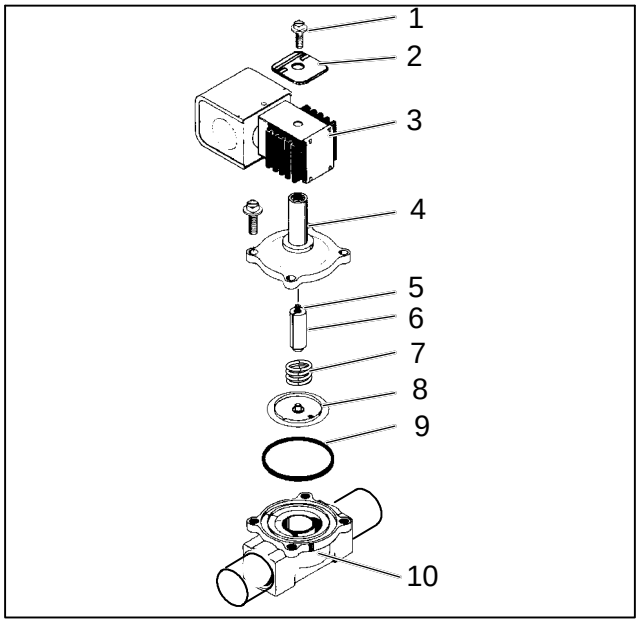
c. Disconnect wire leads to coil.

d. Remove valve assembly from bracket.

e. Install new valve and re-connect hoses. It is not necessary to disassemble the valve when installing.

f. Refill and bleed coolant lines.

g. Connect wire leads and test operation.



1. Coil Retaining Screw
2. Nameplate
3. Coil Housing Assembly
4. Enclosing Tube & Bonnet Assembly
5. Kick-Off Spring
6. Plunger
7. Closing Spring
8. Diaphragm
9. O-Ring
10. Valve Body

Figure 4-9. Heat Valve

4.15 SERVICING THE LIQUID LINE SOLENOID VALVE

The Liquid line solenoid valve (Figure 4-10) is very similar to the heat valve. It requires no maintenance unless a malfunction to the internal parts or coil occurs. This may be caused by foreign material such as: dirt, scale, or sludge in the refrigeration system, or improper voltage to the coil.

There are only three possible valve malfunctions: coil burnout, failure to open, or failure to close.

Coil burnout may be caused by the following:

1 Improper voltage.

2 Continuous over-voltage, more than 10% or under-voltage of more than 15%.

3 Incomplete magnet circuit due to the omission of the coil hosing or plunger.

4 Mechanical interface with movement of plunger which may be caused by a deformed enclosing tube.

Failure to open may be caused by the following:

1 Coil burned out or an open circuit to coil connections.

2 Improper voltage.

3 Defective plunger or deformed valve body assembly.

Failure to close may be caused by the following:

1 Defective plunger or deformed valve body assembly.

2 Foreign material in the valve.

4.15.1 Coil Replacement

a. It is not necessary to remove the refrigerant charge from the system.

b. .Place main battery disconnect switch in OFF position and lock.

c. Disconnect wire leads to coil.

d. Remove coil retaining clip and nameplate.

e. Lift burned-out coil from enclosing tube and replace.

f. Connect wire leads and test operation

4.15.2 Internal Part Replacement

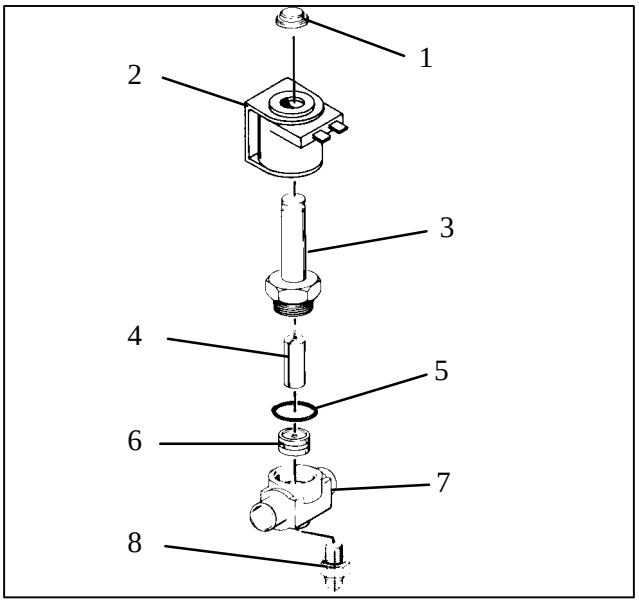
a. Place main battery disconnect switch in OFF position and lock.

b. Perform a low side pump down. Refer to paragraph 4.5.1.

c. Slowly loosen enclosing tube assembly to bleed any remaining pressure from the valve. Disassemble valve and replace defective parts.

d. Assemble valve and leak check.

e. Evacuate low side and re-open system.



1. Snap Cap
2. Coil Assembly
3. Enclosing Tube Assembly
4. Plunger Assembly
5. Gasket
6. Piston Assembly
7. Body
8. Bracket Adapter

Figure 4-10. Liquid Line Solenoid Valve

4.15.3.Replace Entire Valve

a. Perform a low side pump down, remove coil and plunger assembly and un-braze valve from lines.

b. Remove valve assembly from bracket.

c. Disconnect wire leads to coil.

d. Disassemble new valve, to protect internal parts, and solder to lines.

e. Assemble and leak check valve.

f. Evacuate low side and re-open system.

g. Connect wire leads and test operation.

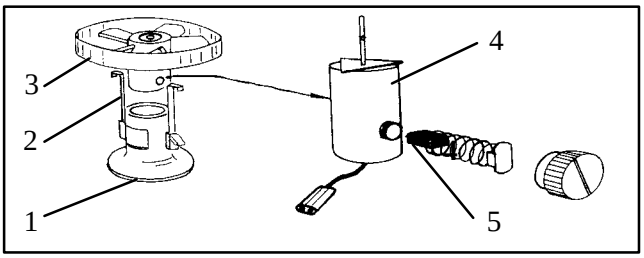
4.16 CONDENSER FAN/MOTOR ASSEMBLY

4.16.1 Removal

a. Place main battery disconnect switch in OFF position and lock.

b. Unlatch motor draw latches. See Figure 4-11.

c. Disconnect motor wire harness and lift motor out of unit.



1. Motor Support
2. Draw Latch
3. Fan/Motor Assembly
4. Motor
5. Brush

Figure 4-11. Condenser Fan/Motor Assembly

4.16.2 Inspection And Cleaning

a. At regular maintenance periods, remove brush covers, examine and clean motor interior.

b. Place main battery disconnect switch in OFF position and lock.

c. Remove all foreign material. such as dirt and carbon dust with dry moderately compressed air. Clean by suction if possible to avoid blowing foreign matter into the motor.

d. Confirm free movement of brushes to prevent binding.

e. Examine brush wear and general condition. If broken, cracked chipped or worn to 1/3 the original length, replace. Refer to paragraph 4.16.3.

f. Examine the condition of the brush springs. A discolored spring is a sign of overheating which may weaken the spring. If discolored, replace.

g. Observe condition of communtator and armature coils

4.16.3 Brush Replacement

a. Place main battery disconnect switch in OFF position and lock.

b. Remove condenser motor, refer to paragraph 4.16.1.

c. Remove brush covers, remove and inspect brush assemblies. Replace if required.

d. Replace brush covers and reinstall condenser motor.

e. To reassemble, reverse the above procedure. Ensure motor is properly seated in support.

f. Verify the proper operation of motor.

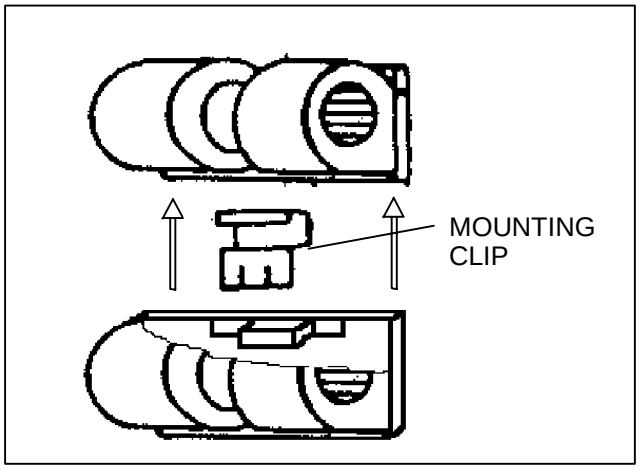


Figure 4-12. Evaporator Fan Removal

4.17 REPLACING EVAPORATOR FAN

a. Place main battery disconnect switch in OFF position and lock.

b. Disconnect wire leads to the motor. Mark leads for proper reassembly.

c. Remove motor by lifting the mounting clip (see Figure 4-12) up and out. Slide motor from unit.

d. To reassemble, reverse procedure.

4.18 REPLACING RETURN AIR FILTERS

The return air filters are located behind the return air grill, inside the vehicle.

The filters should be checked for cleanliness periodically depending on operating conditions. A dirty filter will restrict air flow over the evaporator coil which may cause insufficient cooling or heating and possible frost buildup on the coil. To remove the filters, do the following.

a. Place main battery disconnect switch in OFF position and lock.

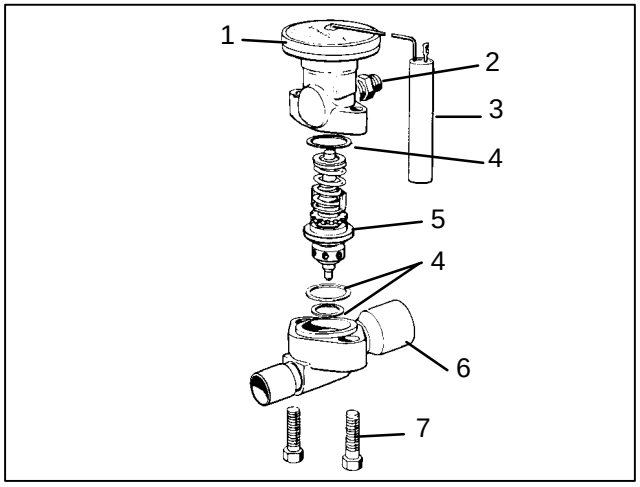
b. Remove the return air grille.

c. Loosen filter retaining clips and remove the filter from the grille.

d. Reverse procedure to install new filters.

4.19 THERMOSTATIC EXPANSION VALVE

The thermostat expansion valve (Figure 4-13) is an automatic device which maintains constant superheat of the refrigerant gas leaving the evaporator regardless of suction pressure. The valve functions are: (a) automatic control of refrigerant flow to match the evaporator load and (b) prevention of liquid refrigerant entering the compressor. Unless the valve is defective, it seldom requires any maintenance.



1. Power Head Assembly
2. Equalizer Connection
3. Bulb
4. Gasket
5. Cage Assembly
6. Body Flange
7. Cap screw

Figure 4-13. Thermostatic Expansion Valve

4.19.1 Valve Replacement

a. Pump down low side of the unit. (Refer to paragraph 4.5.1)

b. Remove insulation from expansion valve bulb. (See Figure 4-13 and Figure 4-14.)

c. Loosen retaining straps holding bulb to suction line and detach bulb from the suction line.

d. Loosen flare nuts on equalizer line and disconnect equalizer line from the expansion valve.

e. Remove capscrews and lift off power head and cage assemblies and gaskets.

f. Check, clean and remove any foreign material from the valve body, valve seat and mating surfaces. If required, replace valve body.

NOTE

Do not adjust the new replacement expansion valve. Valves are preset at the factory.

g. Using new gaskets, install new cage and power head assemblies.

h. Leak check the new valve and evacuate and dehydrate low side. (Refer to paragraph 4.7.)

i. The thermal bulb is installed below the center of the suction line (four or eight o'clock position). This area must be clean to ensure positive bulb contact. Strap thermal bulb to suction line. Ensure that retaining straps are tight and renew insulation.

j. Fasten equalizer line to the expansion valve.

k. Open filter-drier inlet service valve and compressor service valves.

l. Run the coach for approximately 30 minutes on fast idle.

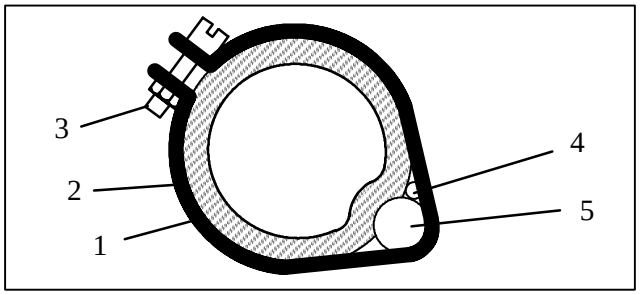
m. Check refrigerant level. (Refer to paragraph 4.8.1)

n. Check superheat. (Refer to paragraph 4.19.2.)

4.19.2 Superheat Measurement

NOTE

All readings must be taken from the TXV bulb location and out of the direct air stream.



1. Suction Line (section view)
2. TXV Bulb Clamp
3. Nut & Bolt (clamp)
4. Thermocouple
5. TXV Bulb (Shown in the 4'clock position)

Figure 4-14.Thermostatic Expansion Valve Bulb and Thermocouple

a. Open top cover. Refer to paragraph 4.2.

b. Remove Presstite insulation from expansion valve bulb and suction line.

c. Loosen one TXV bulb clamp and make sure area under clamp is clean.

d. Place temperature thermocouple in contact with the suction tube and parallel to the TXV bulb, and then secure loosened clamp making sure both bulb and thermocouple are firmly secured to suction line. (SeeFigure 4-14.) Reinstall insulation around the bulb.

e. Connect an accurate low pressure gauge to the low pressure port (9, Figure 1-6)

f. Close top cover being careful to route thermocouple sensing wire and gauge hose outside the unit.

g. Start bus and run on fast idle until unit has stabilized, about 20 to 30 minutes.

NOTE

When conducting this test, the suction pressure must be at least 6 psig *(0.41 bar)* below the expansion valve maximum operating pressure (MOP). Refer to paragraph 1.3 for MOP.

h. From the temperature/pressure chart (Table 4-4), determine the saturation temperature corresponding to the evaporator outlet pressure.

i. Note the temperature of the suction gas at the expansion valve bulb. Subtract the saturation temperature from this temperature. The difference is the superheat of the suction gas.

j. The superheat may cycle from a low to high reading. Monitor the superheat taking readings every 3–5 minutes for a total of 5–6 readings. Calculate the superheats, add the readings and divide by the number of readings taken to determine average superheat. The superheat should be 10°F to 12°F.

k. If superheat is not within tolerance, replace the valve.

4.20 COMPRESSOR MAINTENANCE

4.20.1 Removing the Compressor

If compressor is inoperative and the unit still has refrigerant pressure, isolate the compressor and remove the refrigerant. Refer to paragraph 4.5.2. If compressor is operative, perform a pump down. Refer to paragraph 4.5.3.

a. Place main battery disconnect switch in OFF position and lock.

b. Loosen bolts at suction and discharge service valve flanges and break seal to be sure pressure is released. remove bolts.

c. Tag and disconnect wiring to the high pressure and low pressure switch, unloaders and clutch.

d. Remove four bolts holding compressor to base

e. Attach sling or other device to the compressor and remove compressor from the coach through the rear access door.

NOTES

1 Service replacement compressors are sold without service valves. Valve pads are installed in their place. The optional unloaders are not supplied, as the cylinder heads are shipped with plugs. Customer should retain the original unloader valves for use on the replacement compressor.

2 The piston plug that is removed from the replacement compressor head must be installed in the failed compressor if returning for warranty or core credit.

3 Do not interchange allen-head capscrews that mount the piston plug and unloader, they are not interchangeable.

4 Check oil level in service replacement compressor. (Refer to paragraphs 1.3 and 4.20.3.)

f. Remove the three socket head capscrews from the cylinder head(s) that have unloader valves installed. See Figure 4-15. Remove the unloader valve and bypass piston assembly, keeping the same capscrews with the assembly. The original unloader valve must be transferred to the replacement compressor. The plug arrangement removed from the replacement is installed in the original compressor as a seal. If piston is stuck, it may be extracted by threading a socket head capscrew into top of piston. A small Teflon seat ring at the bottom of the bypass piston plug must be removed.

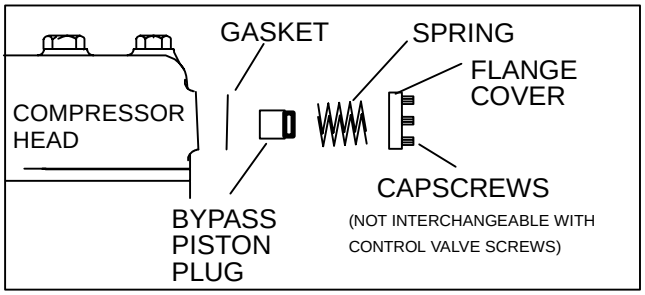


Figure 4-15.Removing Bypass Piston Plug

g. Remove the pressure switches and install on replacement compressor after checking switch operation (refer to paragraph 4.10).

h. Remove clutch assemble and retain original clutch key. Install on replacement compressor. Refer to paragraph 4.20.2.

i. Install compressor in unit by performing the removal steps in reverse. It is recommended that new locknuts be used when replacing compressor. Install new gaskets on service valves and tighten bolts uniformly.

j. Leak check connections and replace filter–drier. Refer to paragraph 4.6.

k. Using refrigerant hoses designed for vacuum service, connect a vacuum pump (see Figure 4-5) and evacuate compressor to 500 microns. Front seat both manifold valves to isolate the pump.

l. Start unit and check refrigerant level (refer to paragraph 4.8.1).

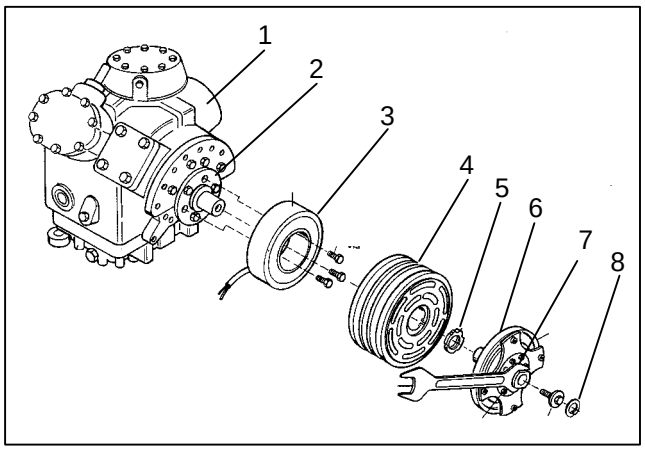
m. Check compressor oil level (refer to paragraph 4.20.3). Add or remove oil if necessary.

n. Check compressor unloader operation.

o. Remove manifold gauge set.

4.20.2 Transferring Compressor Clutch

To remove a clutch (see Figure 4-16) from a compressor and install on a replacement compressor, do the following:



1. Compressor (typical)
2. Seal Cover
3. Coil
4. Rotor
5. Rotor Nut
6. Armature
7 Spacer Nuts
8. Snap Ring

Figure 4-16. Compressor Clutch

a. Using a wrench on the armature flats to keep it from turning, remove the special bolt holding it to the shaft.

b. Using special tool (CTD Part Number 07–00242 –01), remove the rotor nut and rotor. Retain original key.

c. Noting the position of the wire, remove the three bolts holding the coil to the compressor.

d. Remove every other bolt from the seal cover of the new compressor in the same manner as the original compressor. Mount the coil assembly with the wire in the same orientation as it was mounted on the original compressor. Tighten the mounting bolts to 45 lbs/ft (6.2 mkg).

e. Mount rotor on shaft with rotor nut. Be sure pulley turns freely without binding.

f. Install armature on shaft using original key and tighten mounting bolt to 20 ft/lbs (2.8 mkg).

g. Perform a check of the air gap between the inside face of the armature and the mating face of the rotor. The air gap should be measured with a minimum of 50 psig (3.4 bar) in the crankcase. A preliminary check may be performed before the crankcase is pressurized but a final check must be performed before the clutch is operated. The gap should be between 0.016 and

0.030 inch (0.41 to 0.76 mm). If required, remove the eight armature spacer nuts and spacer. Add or remove shims to adjust gap. Reinstall spacer nuts and tighten to 7–8 ft/lbs(1.0 to 1,1 mkg).

h.Reconnect wiring and test clutch operation.

4.20.3 Compressor Oil Level

To check, and if required correct, the compressor oil level do the following:

a. Operate the coach for at least one–half hour at fast idle speed, with the temperature controls at the coolest setting, and the compressor fully loaded. It may be necessary to pre–heat the coach and/or operate the system in the reheat mode to keep the compressor fully loaded throughout this procedure

b. Ensure the system is fully charged (refer to paragraph 4.8.1) and the compressor crankcase is warm to the touch after fifteen minutes of operation.

c. Shut off the system and immediately record the oil level in the compressor sight glass. See Figure 4-17. If the compressor is not level, an average between the sight glass levels will have to be made to determine level.

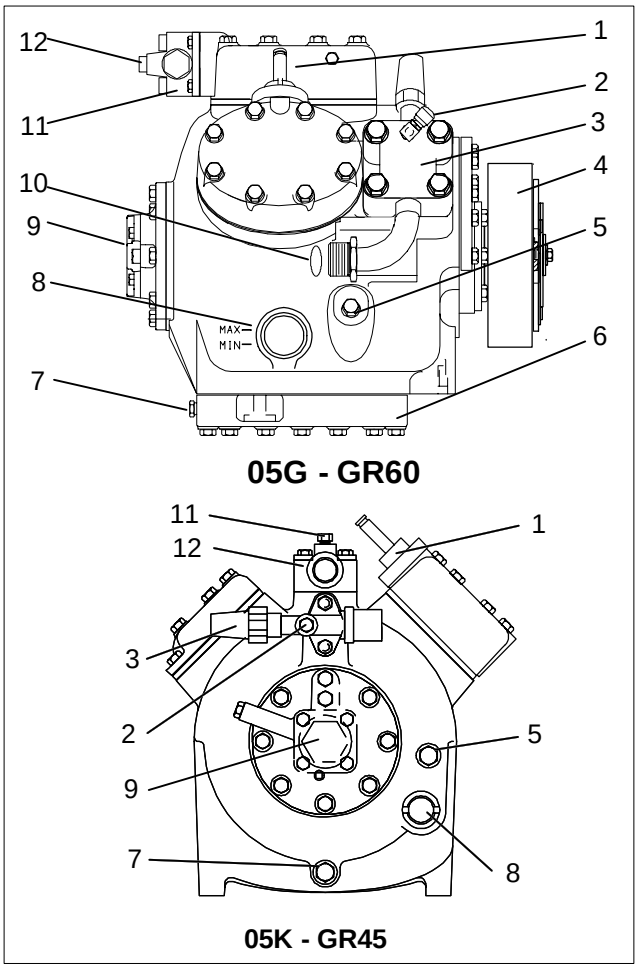
d. The proper oil level is between the marks on the compressor crankcase (05G compressors) or between 1/4 and 1/2 of the sight glass (05K compressors). Refer to Figure 4-17. If the oil level is correct, release the coach into service. If the level is above the required amount, proceed to step e.. If the level is below the required amount proceed to step f.

e. To remove oil and bring the level to the proper amount, do the following:

1. Pump down the compressor until only a slight positive pressure remains in the crankcase. Refer to paragraph 4.5.3.
2. Shut off the coach engine and ensure the compressor discharge and suction service valves are frontseated. Reclaim the remaining refrigerant in the compressor crankcase.
3. Drain or pump out compressor oil until the level is brought to the minimum for this compressor.
4. Evacuate the compressor to 500 microns. Backseat the compressor service valves and repeat the oil level check procedure.

f. To add oil to the compressor crankcase, do the following:

1. With the system off, connect a manifold gauge set to the compressor suction and discharge service valves (See Figure 4-5) and reclaim the refrigerant to below atmospheric pressure. Shut off the reclaimer and verify the pressure does not rise. If the pressure rises, continue reclaiming until the pressure remains below atmospheric.
2. Add oil to compressor crankcase slowly, through the oil fill plug opening (see Figure 4-17) to bring level to mid range of allowed levels.
3. Evacuate compressor to 500 microns. Backseat compressor suction and discharge valves, start system and recheck oil level.
4. Remove manifold gauge set.



1.	Electric Unloader Valve	6.	Bottom Plate
2.	Suction Service Valve Charging Port	7.	Oil Drain Plug
3.	Suction Service Valve	8.	Oil Level Sight Glass
4.	Clutch	9.	Oil Pump
5.	Oil Fill Plug	10.	O-ring
		11	.Discharge Service Valve
		12	.Service Port

Figure 4-17. Compressors

4.20.4 Checking Unloader Operation

To check unloader operation do the following:

a. Install a manifold gauge set as shown in Figure 4-6. Ensure both manifold valves are frontseated and center connection is tight on blank fitting.

b. Midseat compressor suction service valve.

c. At the bus roof, disconnect the suction pressure transducer (8, Figure 1-6). This will force the controller to energize the unloader(s).

d. Start the bus and run in cooling lower set point if required to ensure system remains in full speed cooling.

e. Locate the unloader connector at the compressor. Observe manifold suction gauge while unplugging the

connector. Pressure should decrease 3 to 5 psi (0.2 to 0.4 bar) when the unloader is unplugged and increase the same amount as the plug is reconnected. repeat test for second unloader if fitted.

f. If pressures do not react as described, check unloader coil or repair unloader mechanism as required.

g. When testing is complete, reconnect transducer and unloader connectors and remove manifold gauge set.

h. Disconnection of the suction pressure transducer will cause an "A15" alarm. Once the transducer is reconnected, the alarm will go to inactive and can then be cleared.

Table 4-1. Temperature Sensor Resistance

Temperature		Resistance In Ohms
°F	°C	
-20	-28.9	165,300
-10	-23.3	117,800
0	-17.8	85,500
10	-12.2	62,400
20	- 6.7	46,300
30	- 1.1	34,500
32	0	32,700
40	4.4	26,200
50	10.0	19,900
60	15.6	15,300
70	21.1	11,900
77	25	10,000
80	26.7	9,300
90	32.2	7,300
100	37.8	5,800
110	43.3	4,700
120	48.9	3,800

4.21 TEMPERATURE SENSOR CHECKOUT

a. An accurate ohmmeter must be used to check resistance values shown in Table 4-1.

b. Due to variations and inaccuracies in ohmmeters, thermometers or other test equipment, a reading within two percent of the chart value would be considered accaptable. If a sensor is bad, the resistance value would usually be much higher or lower than the value given in Table 4-1 .

c. At least one sensor lead must be disconnected from the controller before any reading can be taken. Not doing so will result in a false reading. Two preferred methods of determining the actual test temperature at the sensor are an ice bath at 32°F *(0°C)* and/or a calibrated digital temperature meter.

4.22 PRESSURE TRANSDUCER CHECKOUT

NOTE

System must be operating to check transducers.

a. With the system running use the driver display or manifold gauges to check suction and/or discharge pressure(s).

b. Use a digital volt-ohmmeter measure voltage across the transducer at terminals A & C. See Figure 4-18. Compare to values in Table 4-2. A reading within two percent of the values in the table would be considered good.

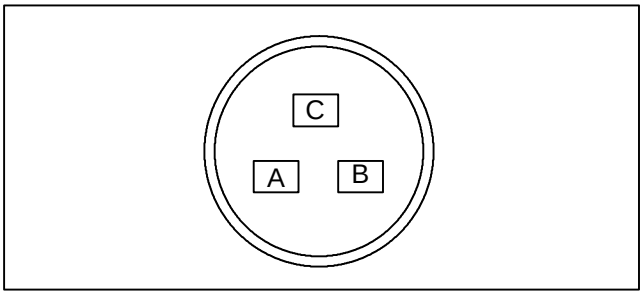


Figure 4-18 Transducer Terminal Location

4.23 REPLACING SENSORS AND TRANSDUCERS

a. Place main battery disconnect switch in OFF position and lock.

b. Tag and disconnect wiring from defective sensor or transducer.

c. Remove and replace defective sensor or transducer.

d. Connect wiring to replacement sensor or transducer.

e. Checkout replacement sensor or transducer. (Refer to section 4.21 or 4.22, as applicable.)

f. Repair or replace any defective component(s), as required.

4.24 LOGIC BOARD CONFIGURATION

If a replacement Logic Board is installed, it is necessary to match the configuration jumpers (see Figure 1-10) to the original board. Table 4-3 provides a list of jumper functions

Table 4-2. PressureTransducer Voltage

"/hg	Voltage	Psig	Voltage	Psig	Voltage
20"	0.369	100	1.446	215	2.573
10"	0.417	105	1.495	220	2.622
Psig	**Voltage**	110	1.544	225	2.671
0	0.466	115	1.593	230	2.720
5	0.515	120	1.642	235	2.769
10	0.564	125	1.691	240	2.818
15	0.614	130	1.740	245	2.867
20	0.663	135	1.789	250	2.916
25	0.712	140	1.838	255	2.965
30	0.761	145	1.887	260	3.014
35	0.810	150	1.936	265	3.063
40	0.858	155	1.985	270	3.112
45	0.907	160	2.034	275	3.161
50	0.956	165	2.083	280	3.210
55	1.007	170	2.132	285	3.259
60	1.054	175	2.181	290	3.308
65	1.103	180	2.230	295	3.357
70	1.152	185	2.279	300	2.406
75	1.204	190	2.328	305	3.455
80	1.250	195	2.377	310	3.504
85	1.299	200	2.426	315	3.553
90	1.348	205	2.475	320	3.602
95	1.397	210	2.524	325	3.651

Table 4-3. Logic Board Configuration

Jumper	Description
A.	High Reheat – Selects fan speed
B.	High Vent – Selects fan speed
C.	Dry Heat – Selects re-heat configuration
D.	Reheat/Cycle – Selects clutch cycle
E.	Transducers – Selects transducer configuration
F.	Refrigerant – Selects refrigerant
G.	Unit Type – Selects software configuration
H.	Unit Type – Selects software configuration
I.	Factory – Reserved for the manufacturer.
J.	Invert H_2O – Selects temperature switch configuration
K.	Voltage – Selects unit voltage
L.	Factory – Reserved for the manufacturer.
M.	Psig/Bars – Selects display configuration
N.	°C/°F – Selects display configuration
O.	Loaded Start – Selects start-up configuration
P.	PI Reheat – Selects reheat algorithm

Table 4-4. R-134a Temperature - Pressure Chart

Temperature		Vacuum			
°F	°C	"/hg	cm/hg	kg/cm@	bar
-40	-40	14.6	49.4	37.08	0.49
.35	.37	12.3	41.6	31.25	0.42
-30	-34	9.7	32.8	24.64	0.33
-25	-32	6.7	22.7	17.00	0.23
-20	-29	3.5	11.9	8.89	0.12
-18	-28	2.1	7.1	5.33	0.07
-16	-27	0.6	2.0	1.52	0.02

Temperature		Pressure			
°F	°C	psig	kPa	kg/cm@	bar
-14	-26	0.4	1.1	0.03	0.03
-12	-24	1.2	8.3	0.08	0.08
-10	-23	2.0	13.8	0.14	0.14
-8	-22	2.9	20.0	0.20	0.20
-6	-21	3.7	25.5	0.26	0.26
-4	-20	4.6	31.7	0.32	0.32
-2	-19	5.6	36.6	0.39	0.39
0	-18	6.5	44.8	0.46	0.45
2	-17	7.6	52.4	0.53	0.52
4	-16	8.6	59.3	0.60	0.59
6	-14	9.7	66.9	0.68	0.67
8	-13	10.8	74.5	0.76	0.74
10	-12	12.0	82.7	0.84	0.83
12	-11	13.2	91.0	0.93	0.91
14	-10	14.5	100.0	1.02	1.00
16	-9	15.8	108.9	1.11	1.09
18	-8	17.1	117.9	1.20	1.18
20	-7	18.5	127.6	1.30	1.28
22	-6	19.9	137.2	1.40	1.37
24	-4	21.4	147.6	1.50	1.48
26	-3	22.9	157.9	1.61	1.58

Temperature		Pressure			
°F	°C	psig	kPa	kg/cm@	bar
28	-2	24.5	168.9	1.72	1.69
30	-1	26.1	180.0	1.84	1.80
32	0	27.8	191.7	1.95	1.92
34	1	29.6	204.1	2.08	2.04
36	2	31.3	215.8	2.20	2.16
38	3	33.2	228.9	2.33	2.29
40	4	35.1	242.0	2.47	2.42
45	7	40.1	276.5	2.82	2.76
50	10	45.5	313.7	3.20	3.14
55	13	51.2	353.0	3.60	3.53
60	16	57.4	395.8	4.04	3.96
65	18	64.1	441.0	4.51	4.42
70	21	71.1	490.2	5.00	4.90
75	24	78.7	542.6	5.53	5.43
80	27	86.7	597.8	6.10	5.98
85	29	95.3	657.1	6.70	6.57
90	32	104.3	719.1	7.33	7.19
95	35	114.0	786.0	8.01	7.86
100	38	124.2	856.4	8.73	8.56
105	41	135.0	930.8	9.49	9.31
110	43	146.4	1009	10.29	10.09
115	46	158.4	1092	11.14	10.92
120	49	171.2	1180	12.04	11.80
125	52	184.6	1273	12.98	12.73
130	54	198.7	1370	13.97	13.70
135	57	213.6	1473	15.02	14.73
140	60	229.2	1580	16.11	15.80
145	63	245.6	1693	17.27	16.93
150	66	262.9	1813	18.48	18.13
155	68	281.1	1938	19.76	19.37

SECTION 5

ELECTRICAL

5-1 INTRODUCTION

This section includes electrical wiring schematics. The schematic shown in this section provides information for all unit models and optional configurations. For model GR45 units, which are fitted with four evaporator and condenser fans, the components used to control the fifth and sixth fans are not energized. For applications with OEM supplied operating switches, the switches are wired to Logic Board connector J3 as shown. For units with a Micromate as the operators control, there is no wiring to the Logic Board J3 connector. The Micromate is hard wired to the Logic Board connector J2 in the same manner as shown for service port use.

SYMBOLS

LEGEND

SYMBOL	DESCRIPTION
ATS	AMBIENT TEMPERATURE SENSOR
BPS	BOOST PUMP SIGNAL
CB1	CIRCUIT BREAKER, EF1
CB2	CIRCUIT BREAKER, EF2
CB3	CIRCUIT BREAKER, EF3
CB4	CIRCUIT BREAKER, EF4
CB5	CIRCUIT BREAKER, EF5
CB6	CIRCUIT BREAKER, EF6
CB7	CIRCUIT BREAKER, CF1
CB8	CIRCUIT BREAKER, CF2
CB9	CIRCUIT BREAKER, CF3
CB10	CIRCUIT BREAKER, CF4
CB11	CIRCUIT BREAKER, CF5
CB12	CIRCUIT BREAKER, CF6
CB13	CIRCUIT BREAKER, MISC
CF1	COND MOTOR 1
CF2	COND MOTOR 2
CF3	COND MOTOR 3
CF4	COND MOTOR 4
CF5	COND MOTOR 5
CF6	COND MOTOR 6
CTH	COMPRESSOR CLUTCH
D2	EF1/2 LED ASSEMBLY
D6	EF3/4 LED ASSEMBLY
D14	EF5 LED ASSEMBLY
D17	EF6 LED ASSEMBLY
D26	CF1/2 LED ASSEMBLY
D30	CF3/4 LED ASSEMBLY
D38	CF5 LED ASSEMBLY
D41	CF6 LED ASSEMBLY
D51	CLUTCH LED ASSEMBLY
D54	UV1 LED ASSEMBLY
D57	UV2 LED ASSEMBLY
D60	FRESH AIR VALVE LED ASSEMBLY
D63	RSV LED ASSEMBLY
D66	ALARM LED ASSEMBLY
D72	SPARE LED ASSEMBLY
DPT	DISCHARGE PRESSURE TRANSDUCER
EM1	EVAP MOTOR 1
EM2	EVAP MOTOR 2
EM3	EVAP MOTOR 3
EM4	EVAP MOTOR 4
EM5	EVAP MOTOR 5
EM6	EVAP MOTOR 6
F	FUSE
FAV	FRESH AIR VALVE
FTS	FREEZE TEMPERATURE SENSOR
HV	HEAT VALVE
K1	EF1/2 RELAY
K2	EF3/4 REALY
K3	EF5 RELAY
K4	EF6 RELAY
K7	CF1/2 RELAY
K8	CF3/4 RELAY
K9	CF5 RELAY
K10	CF6 RELAY
K13	CLUTCH RELAY
K14	UV1 RALAY
K15	UV2 RELAY
K16	FRESH AIR RELAY
K17	HEAT RELAY
K18	FAULT RELAY
K19	BOOST RELAY
K20	SPARE RELAY
K21	EVAP. FAN HIGH RELAY
K22	EVAP. FAN LOW RELAY
K23	COND. FAN HIGH RELAY
K24	COND. FAN LOW RELAY
LPS	LOW PRESSURE SWITCH
LLS	LIQUID LINE SOLENOID
RAS	RETURN AIR SENSOR
SPT	SUCTION PRESSURE TRANSDUCER
UV1	UNLOADER SOLENOID VALVE #1
UV2	UNLOADER SOLENOID VALVE #2
WTS	WATER TEMPERATURE SWITCH

CONNECTOR LEGEND

SYMBOL	DESCRIPTION
J1	LOGIC POWER
J3	ON/TEST
J4	INPUT
J5	RELAY BOARD INTERFACE
J6	SENSOR
J7	DIAGNOSTIC LINK
JP1	MOTOR OVERLOAD
JP2	LOGIC BOARD INTERFACE
JP3	BOOST PUMP
JP4	CLUTCH
JP5	HEAT/FAIL
JP6	UNLOADER
W_ATS	AMBIENT TEMPERATURE SENSOR
W_COMP	COMPRESSOR
W_FAV	FRESH AIR VALVE
W_HPS	HIGH PRESSURE SWITCH
W_LPS	LOW PRESSURE SWITCH
W_LLS	LIQUID LINE
W_WTS	WATER TEMPERATURE SWITCH

Figure 5-1. Electrical Wiring Schematic Diagram - Legend

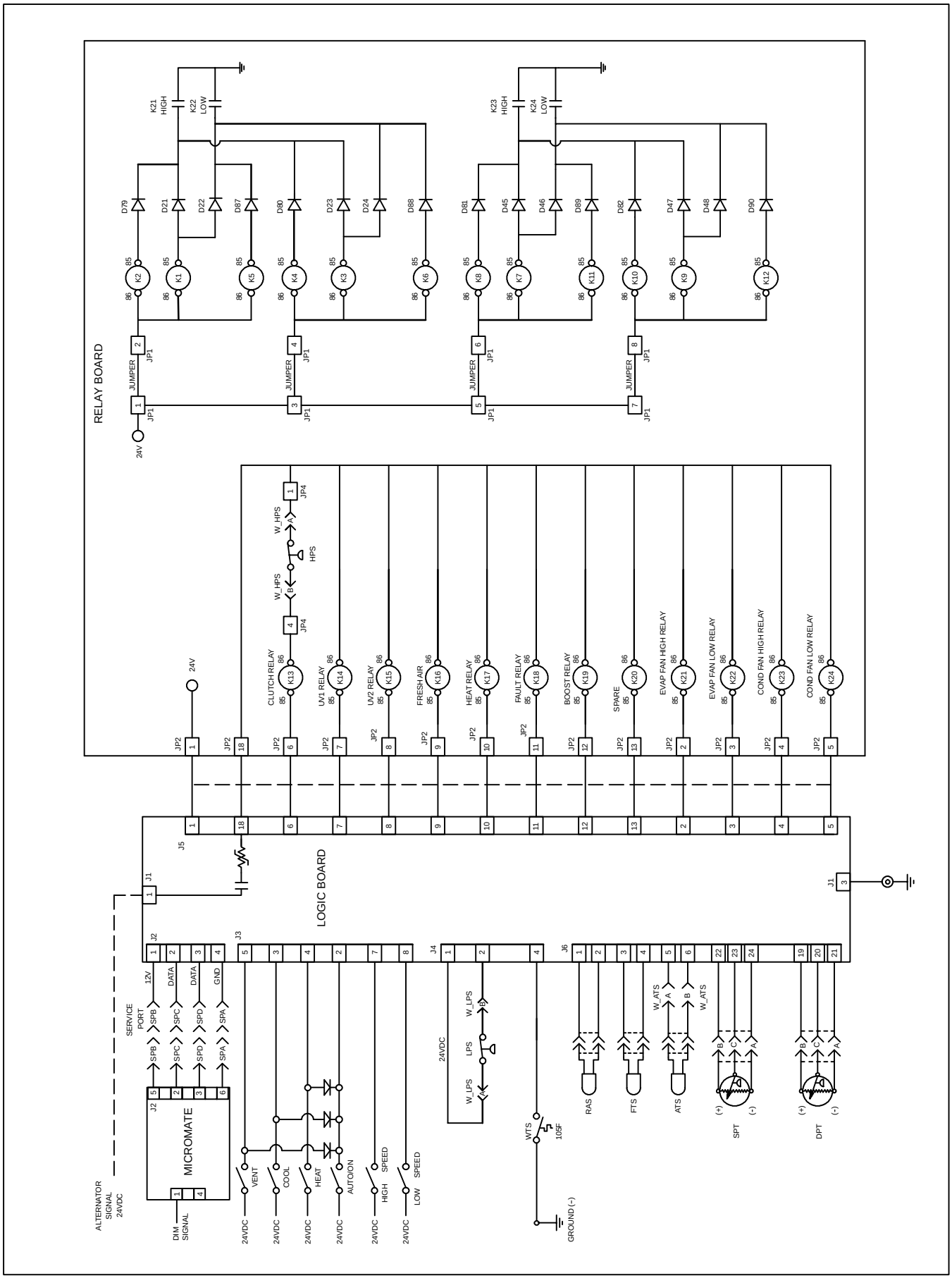


Figure 5-2. Wiring Schematic, Permanent Magnet Motors - Interconnection

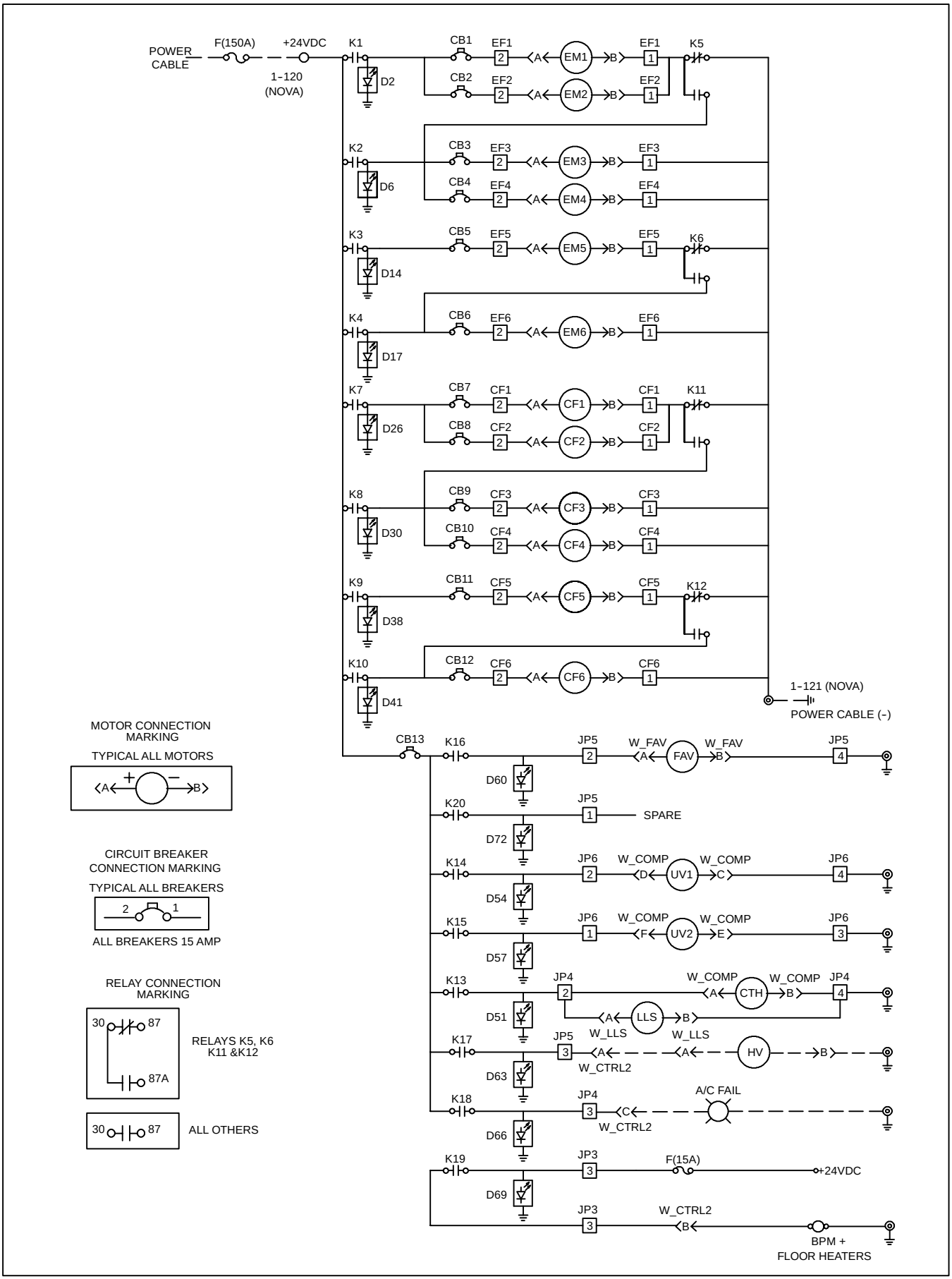


Figure 5-3. Wiring Schematic, Permanent Magnet Motors - Relays to External Components

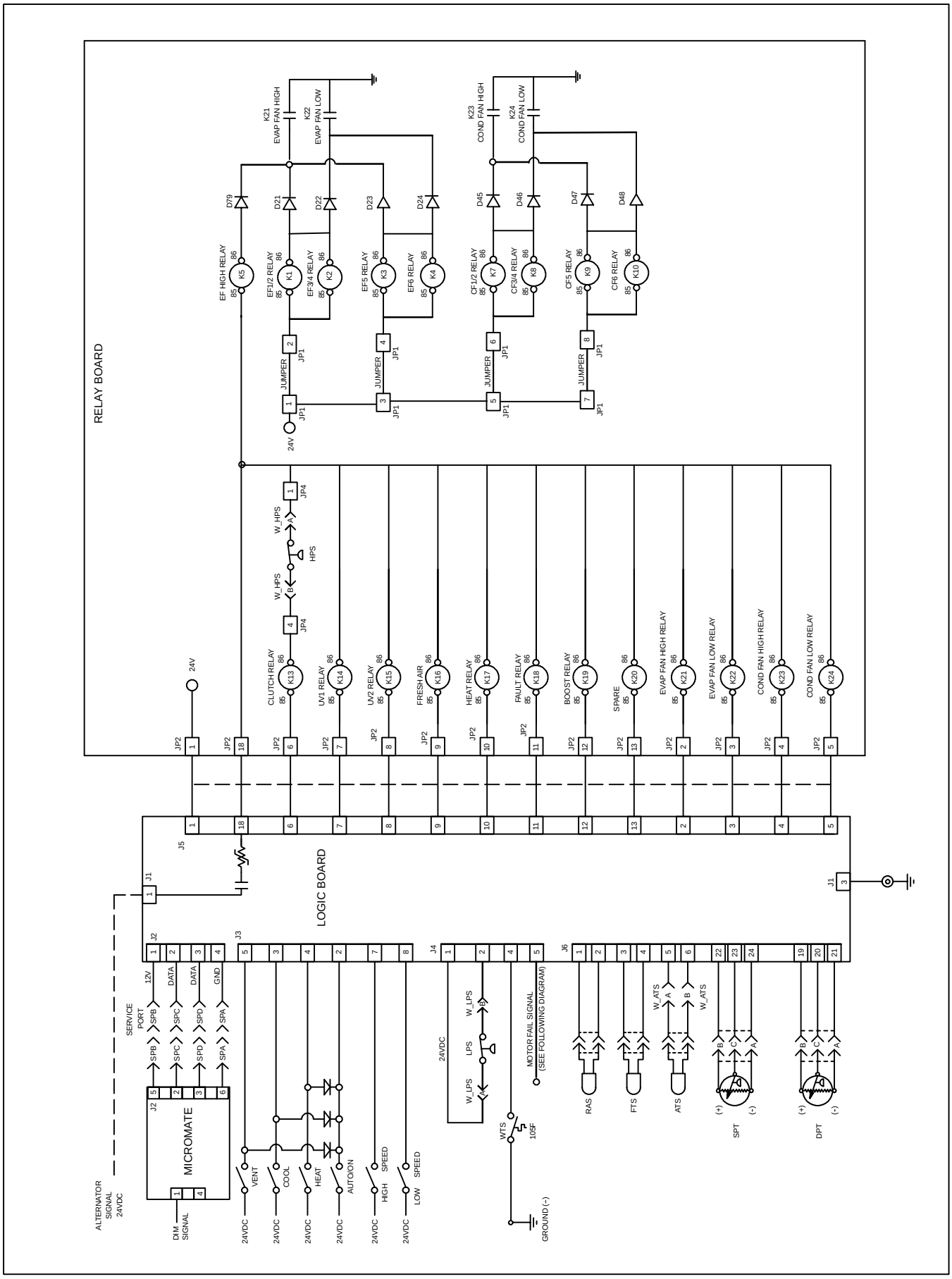


Figure 5–4. Wiring Schematic, Electronically Communtated Motors - Interconnection

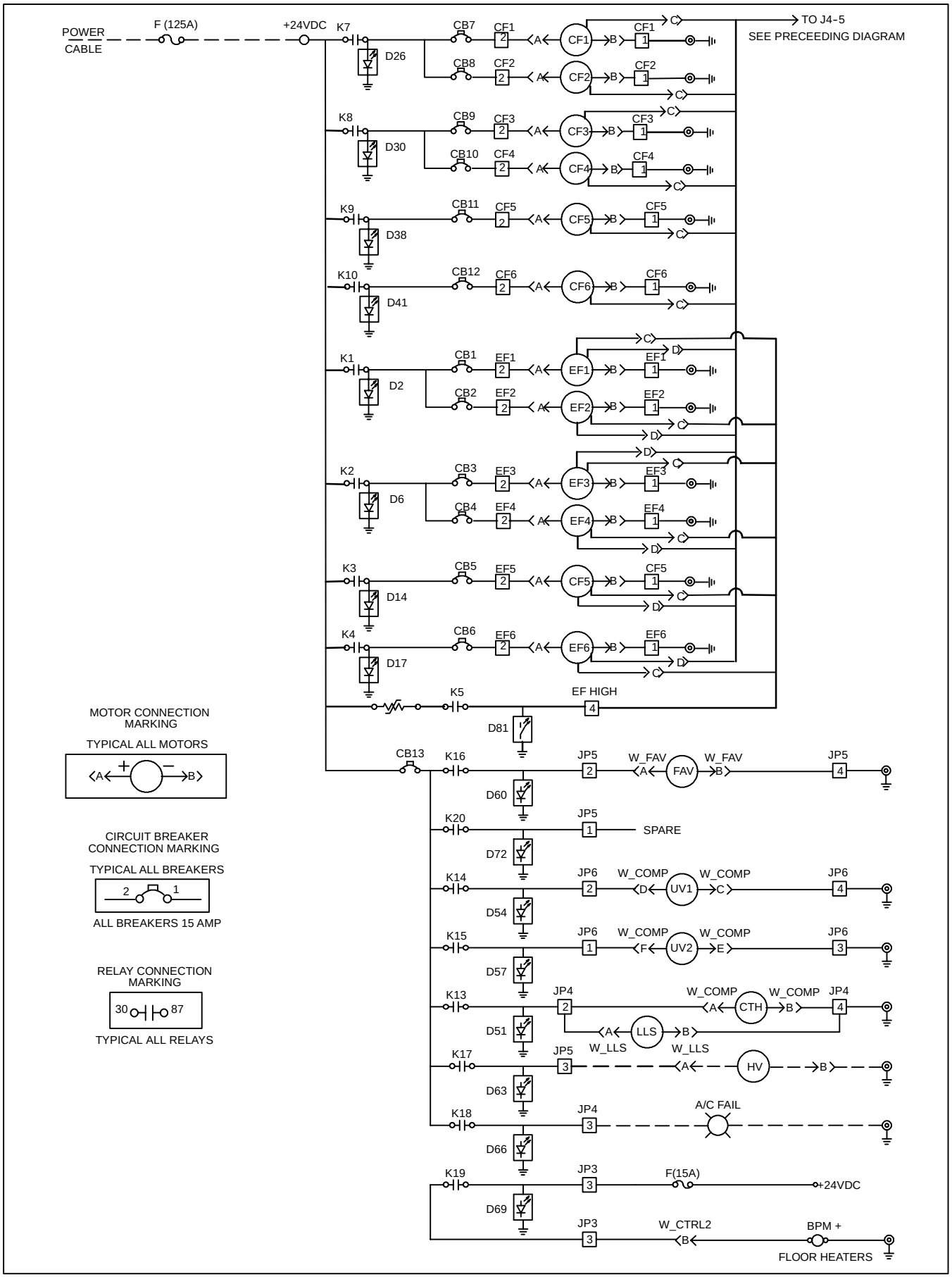


Figure 5-5. Wiring Schematic, Electronically Communtated Motors - Relays To External Components

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